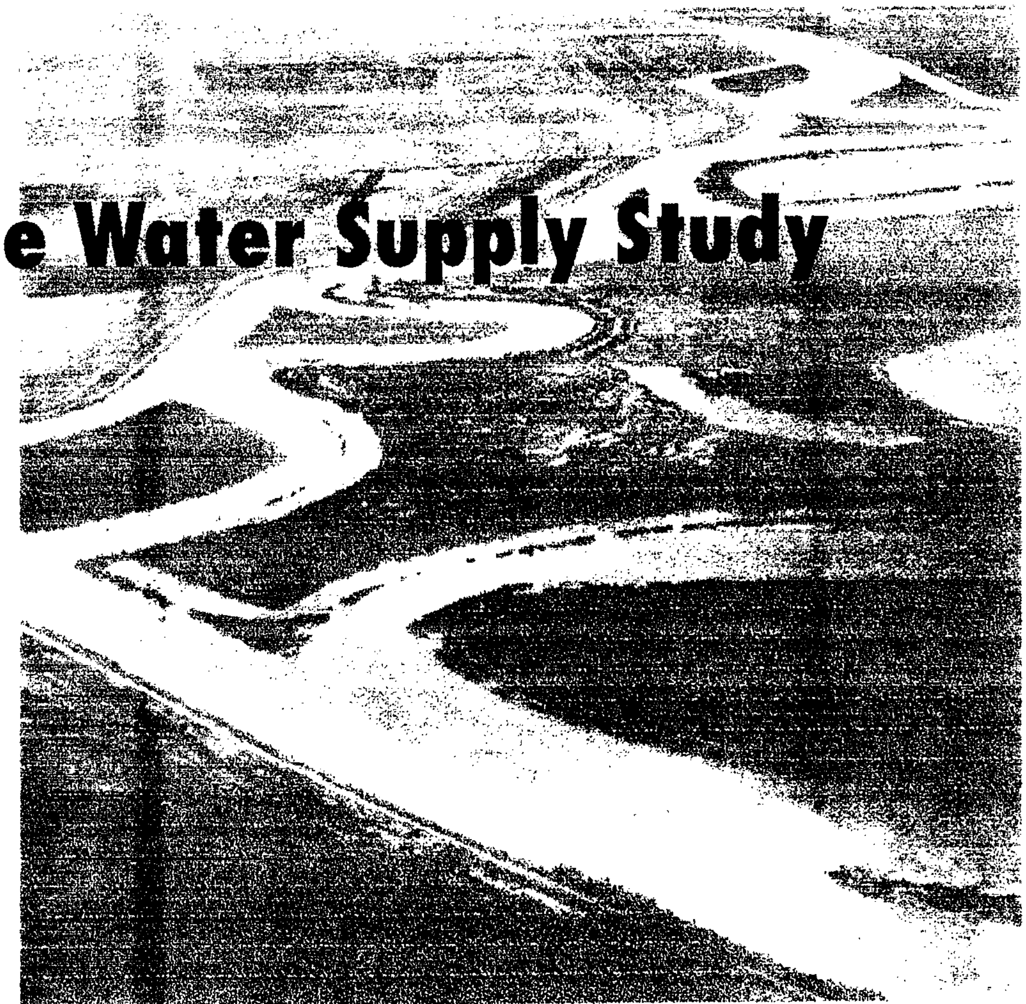
CONTRA COSTA
WATER DISTRICT

Rossana L. Riggs
Administrative Secretary
Planning Department

2300 Stanwell Drive
P.O. Box H_2O
Concord, CA 94524-2099

(925) 688-8147
FAX (925) 688-8303

Future Water Supply Study



Final Report
August 1996

Contra Costa
Water District

CONTRA COSTA WATER DISTRICT

PLANNING DEPARTMENT

FUTURE WATER SUPPLY STUDY

FINAL REPORT

Gregory Gartrell, Ph.D., Director of Planning

August 1996

CONTRA COSTA WATER DISTRICT

PLANNING DEPARTMENT

Project Team

District Staff

Gregory Gartrell, Ph.D., Director of Planning
Frances Garland, Assistant Project Manager
Margaret Wilkins, Public Information
Manu Ankhad
Richard Denton, Ph.D.
Jean Gardner
Dennis Pisila
Barbara Sarkis
Craig Scott
William Zenoni

Consultants

EDAW, Inc.
Montgomery Watson
Bookman Edmonston
RMI

Contra Costa Water District
Customer Feedback Group

Contra Costa Water District gratefully acknowledges the comments and input of the Customer Feedback Group members who participated in the development of this Study.

Mr. Kelly Anchutz
Plumbers Local 159
Martinez, California

Mr. Tino Bacchini
Contra Costa Farm Bureau
Concord, California

Ms. Gloria Cannon
City of Pittsburg

Mr. Dave Culler
Shell Oil Company
Martinez, California

Mr. John Warsawski
Shell Oil Company
Martinez, CA

Mr. George De la Cruz
Bay Point, California

Mr. Tim Donahue
Sierra Club-Delta Reg. Group
Antioch, California

Mr. Mike Gallagher
Building Industry Association
Eastern Division

Mr. Gordon Gravelle
Antioch, California

Mr. Frank Hamilton
California Cities Water
Bay Point

Mr. John Jackson
Chamber of Commerce
Concord, California

Mr. Erik Jacobsen
Concord, California

Mr. Kevin Coughlin
Concord, California

Ms. Barbara Kendall
League of Women Voters-
Diablo Valley Chapter
Clayton, California

Mr. Kelly McMahon
USS POSCO Industries
Pittsburg, California

Mr. Maury Kallerud
USS POSCO Industries
Pittsburg, California

Mr. Bill McManigal
Councilmember
City of Concord

Mr. Al McNabney
Mt. Diablo Audubon Society
Walnut Creek, California

Mr. Dwight Meadows
Ironhouse Sanitation District
Oakley, California

Mr. Han Ong
Concord, California

Ms. Nancy Parent
Pittsburg, California

Mr. Herb Potter
Concord, California

Mr. Ward Pynn
Mt. Diablo Unified
School District
Concord, California

Ms. Elizabeth Rimbault
Councilmember
City of Antioch

Mr. Dale Sanders
Pacheco, California

Mr. Paul Craig
Martinez, California

Mr. Robert Soderbery
Public Works Director

Ms. Barbara Woodburn
Councilmember
City of Martinez

Mr. Mike Yeraka
General Manager
Diablo Water District

Acronyms and Abbreviations

ABAG	Association of Bay Area Governments
ac-ft	acre-foot, acre-feet
BBID	Byron-Bethany Irrigation District
BMP	Best Management Practices
Bureau	U.S. Bureau of Reclamation
CALFED	Consortium of State and Federal Agencies created through the Bay-Delta Accord
CCCSD	Central Contra Costa Sanitation District
CCWD	Contra Costa Water District (also, the District)
CDFG	California Department of Fish & Game
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CIP	Capital Improvement Program
CNDDB	California Natural Diversity Data Base
CNWS	Concord Naval Weapons Station
CPA	Conservation Program Alternative
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
CVPIA	CVP Improvement Act
CWA	Clean Water Act
DDSD	Delta Diablo Sanitation District
DOHS	Department of Health Services
DM	Demand Management
du	dwelling units
DWD	Diablo Water District
DWR	Department of Water Resources
EA	Environmental Assessment
EBMUD	East Bay Municipal Utility District
ECCID	East Contra Costa Irrigation District
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act (Federal)
FERC	Federal Energy Regulatory Commission
FTE	Full-Time Equivalent
FWSS	Future Water Supply Study
GAC	Granular Activated Carbon
GIS	Geographical Information System
gpcd	gallons per day per capita
gpdpdu	gallons per day per dwelling unit
gpm	gallons per minute
LAFCO	Local Agency Formation Commission
M&I	municipal and industrial
MAF	million acre-feet
MCL	maximum contaminant level

C-099941

mg/l	milligrams per liter
mgd	million gallons per day
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
O&M	Operations and Maintenance
OCAP	Operations Criteria and Plan
PG&E	Pacific Gas and Electric Company
PS	public/semi-public (land use designation)
RO	Reverse Osmosis
RBDD	Red Bluff Diversion Dam
RWQCB	Regional Water Quality Control Board
SERA	Signficant Ecological Resource Area
SH	Single family residential high (County land use designation)
SL	Single family residential low (County land use designation)
SOI	sphere of influence
SRI	Seismic and Reliability Improvement
SWP	State Water Project
SWRCB	State Water Resources Control Board
TA	Technical Appendix
TAF	thousand acre-feet
TCC	Tehama-Colusa Canal
TDS	total dissolved solids
TID	Turlock Irrigation District
TM	Technical Memoranda
TWSA	Treated Water Service Area
UAW	unaccounted for water
ULFT	Ultra Low Flow Toilet
ULL	Urban Limit Line
USBR	U.S. Bureau of Reclamation (also, the Bureau)
USFWS	U.S. Fish and Wildlife Service
WTP	water treatment plant
WUF	Water Use Factor

Table of Contents

Cover: Photo of the Delta by the Department of Water Resources.

LIST OF EXHIBITS

LIST OF EXHIBITS (Continued)

1. Overview of the Future Water Supply Study

The Contra Costa Water District (CCWD, or the District), after approximately two years of data analysis, review, and coordination, has identified a Preferred Alternative to offer customers a high quality, reliable water supply for the next 50 years. The District's Board of Directors (Board) has adopted the Future Water Supply Study, including the Preferred Alternative and District's Implementation Plan developed as a result of the selection of that Alternative. This Final Report of the Future Water Supply Study (FWSS, or the Study) documents the decision-making process that culminated in the District's recommendation. The Study is an important first step in the District's attempt to provide a reliable supply for its existing customers and to meet growing water needs over the next 50 years. It is designed to be a flexible, "living" planning document, with periodic review and updates to respond to changing conditions. A key assumption in the preparation of this Study is that it will be updated approximately every five years.

This chapter provides an overview of the contents of the Study. Detailed analyses are presented in subsequent chapters of the FWSS, as well as Technical Appendices A through H.

NEED FOR THE FUTURE WATER SUPPLY STUDY

The stated mission of the Contra Costa Water District is "to strategically provide a reliable supply of high quality water at the lowest cost possible, in an environmentally responsible manner."

CCWD is a Central Valley Project (CVP) contractor, historically relying almost entirely on the Federal government (the Bureau of Reclamation) to supply its water through the Sacramento-San Joaquin Delta (Delta). The amended contract with the Bureau of Reclamation (the Bureau) provides for the operation of the Los Vaqueros Project, and for a maximum delivery of 195,000 acre-feet per year (ac-ft/yr) from the CVP, with a reduction in deliveries during water shortages including regulatory restricted and drought years.

When regulatory restrictions exist, the District's supply can be reduced to the greater of 75% of contract entitlement, or 85% of historical use. Regulatory restrictions could occur as a result of hydrology, as well as environmental requirements such as diversion restrictions or water releases for fish and wildlife uses. In a drought year, currently estimated to occur with a frequency of one year in seven, the Bureau can reduce the District's CVP water to the lesser of 75% of the contract amount or 85% of historical use, but in no event less than 75% of historical use. This has an impact on existing, as well as future customers.

Passage of the CVP Improvement Act of 1992 (CVPIA) established new CVP operating parameters by reforming water distribution pricing and policies. The CVPIA attempts to better balance the needs of water contractors with those of the environment, and includes a dedication of 800,000 ac-ft of CVP yield for environmental purposes. Water allotments under renewed CVP contracts will be based on new estimates of CVP supply that take into account the CVPIA and other new regulations. Consequently, future contract renewals will likely result in reduced water allotments. To meet the 800,000 ac-ft/yr requirement of the CVPIA, future CVP supplies could be reduced by as much as 15 to 20%. If this reduction is spread evenly among the contractors, CCWD could receive as little as 156,000 ac-ft/yr of CVP water during a normal year, and less during regulatory restricted or drought years, beginning between the years 2000 and 2010.

The future of CVP supplies could be further affected by drought shortages; reallocation of agricultural, municipal and industrial entitlements to meet environmental needs; changes in water quality standards in future Bay-Delta proceedings; and the security of the Delta as a transfer system (e.g., levee failure). All future strategies for meeting the District's projected water needs will have to be evaluated in light of these factors.

Changing conditions in the District (e.g., population growth) and other future uncertainties (environmental considerations and the regulatory environment) underscored a need to examine potential water supply options for the future, particularly during drought years. The District therefore prepared the FWSS to analyze potential supply components, as well as conservation programs, to ensure a high quality, reliable, and low cost water supply for its residential and industrial customers well into the future. Chapter 2 of the FWSS presents a detailed analysis of the key planning issues considered as part of the Study.

THE STUDY PROCESS AND METHODOLOGY

Primary steps of the Study included the following:

- Projecting the future demand for water in CCWD's existing and potential future service areas;
- Developing conservation programs to manage demand levels;
- Identifying both existing and potential supply components to meet projected increases in demand;
- Assembling potential supply and conservation components into Resource Alternatives to meet future demand;
- Screening and evaluating the Resource Alternatives against an established set of criteria;
- Based on the screening and rating of potential Resource Alternatives, identifying a Preferred Alternative for consideration by the District's Board of Directors; and
- Developing a plan to implement the Preferred Alternative.

Each of the steps in the process is summarized below. A discussion of public involvement activities conducted as part of the Study is included as well. Details on each of the steps are provided in subsequent chapters of the FWSS and the Technical Appendices.

DEMAND PROJECTIONS - THE NEED FOR WATER

As demand drives the need for future water supplies, a key component of the FWSS is projected demand levels. Demand forecasts were used to estimate the future need for water, based on such variables as the size of the service area; the rate, pattern and density of growth; land development potential; future land use types and water consumption by land use; population characteristics; and water use habits. By developing and examining alternative future service area scenarios that bracket the range of possible future demand projections, the District explored a logical array of potential future demand values. Considering different service area scenarios allowed the District to identify the significance of service area changes on the adequacy of supplies; this examination, however, does not indicate that the District intends to supply water to any service area examined.

As part of the FWSS, the District defined and examined six Service Areas—Service Areas A through F—to determine a logical array of demand levels and their geographic distribution. The service areas were cumulative geographic areas - that is, Service Area B included Service Area A, plus additional geographical areas. Average annual demand was determined for each Service Area by first reviewing historical data, and then determining the appropriate components to be used in projecting future demand for different customer categories (e.g., Residential, Major Industrial and other Non-Residential). Demand levels were projected for each of the service areas by decade for the years 1990[1] through 2040.

1 1990 demand is not actual but an estimated demand level for 1990, which was used to account for all water use regardless of source and to exclude the effects of drought on water use. Projected and actual 1990 demands differ by less than 2%.

Results of the analysis showed that projected demand in some of the service areas was very similar. For example, average demand projections for Service Areas A through C differ by only 2% in 1990, with the difference increasing to 7% in 2040. Service Area E differs from Service Area D in 1990 by less than 2% increasing to 8% in 2040. Service Area F increases from 4% above Service Area E in 1990 to 20% in 2040. Such similarities enabled the District to focus further stages of the Study on three of the Service Areas (i.e., C, E and F).

Recognizing the uncertainties inherent in projecting future demand over a 50-year study period, the District also identified a "demand envelope," or range of projected demand values. This envelope brackets the high, average, and low values of projected demand levels for a given service area. Projections in the long term are less certain than the near term; therefore, the envelope increases over the 50-year study period. The envelope of the demand projections ranges from +5/-3% in 1990 to +15/-10% in 2040.

Comparing projected future demand levels with available supply enabled the District to identify potential future shortfalls. Although existing water supplies will meet normal year demand in the year 2000, the District might experience shortfalls in normal years as soon as the year 2010, and in drought years as soon as 2000. Such a near-term potential shortfall underscores the need for the Study.

The detailed analysis of projected demand levels is presented in Chapter 3, with additional supplemental data in Technical Appendix A.

DEMAND MANAGEMENT - CONSERVATION MEASURES AND PROGRAMS

Conservation programs decrease demand, thereby reducing the need for additional water supplies. As part of the FWSS, the District developed three Conservation Program Alternatives (CPAs), consisting of increasingly aggressive and stringent conservation measures to influence future demand. Water savings achieved through implementation of CPA 1, 2 or 3 are in addition to the No Action conservation program, which assumes that existing State and Federal regulations, as well as the normal replacement of fixtures and devices with more efficient models, will increase conservation levels regardless of additional District actions.

Conservation measures are individual conservation practices, such as audits or rebate programs, that increase water use efficiency. Potential measures included as part of the three CPAs were culled from the District's current conservation efforts, Best Management Practices (BMPs) currently in effect, and measures proposed in CVPIA and California Urban Water Conservation agreements. Conservation measures identified to date include: system operations and loss reductions, public information and education, pricing and incentives, ordinances and plan reviews, audits, and the Ultra Low Flow Toilet (ULFT) Rebate Program.

Assembled from various groupings of conservation measures, the three CPAs would result in a range of potential savings in the future. In addition to the assumed savings of 6 to 10% by the year 2040, resulting from the No Action conservation program , CPA 1 is anticipated to achieve an overall District-wide reduction of 5% in the year 2040. CPA 2 would achieve an overall District-wide reduction of 9% in the year 2040, and CPA 3 would be expected to achieve a reduction of 12%. It should be noted that the percent savings varies by customer category. For example, the CPAs require less percentage reductions from Industrial customers, as this customer category already maximizes savings by aggressive conservation practices. Residential customers, however, represent the greatest potential for percentage reductions from conservation practices. When combined with the No Action conservation program, these three programs are projected to save between 11 to 22% in water consumption by the year 2040.

The detailed analysis of conservation programs is presented in Chapter 4, with additional supplemental data in Technical Appendix C.

IDENTIFYING EXISTING AND FUTURE SUPPLY COMPONENTS

CCWD obtains its water primarily from surface water sources in the Sacramento-San Joaquin Delta. CCWD conveys, stores, treats and distributes water through the Contra Costa Canal, a system of storage reservoirs, water treatment facilities and distribution pipelines. Water supply and use in the basin are governed by a complex network of water rights, contracts and agreements involving CCWD, local districts and other entities.

The District's water supply has historically provided safe and reliable water service to customers in Contra Costa County. To ensure the District will continue to provide high quality water service through the year 2040, CCWD investigated water supply improvements. A wide variety of potential supplemental water sources exists throughout the Sacramento-San Joaquin River basins and the District's service area. These potential water sources include water transfers and exchanges, groundwater, water use reductions by others (e.g., crop fallowing or crop shifts), water recycling and desalination.

The single-most important supply component for the District is, and will continue to be, CVP contract water. Based on analysis presented in the FWSS, an additional vital supply component for the future will be surface water transfers from other sources. Recognizing both the importance of identifying potential water transfer opportunities as well as the complexities involved in negotiating such transfers, the District examined potential transfer sources on a separate analysis track. That is, early stages of the Study assumed that surface water transfers would occur, without identifying specific sources. Later stages of the Study considered the sources currently thought to be the most promising opportunities; although specific transfer amounts were identified, individual sources have not yet been determined. However, the District has identified six of the most promising transfer sources based on current market conditions. The selection of the Preferred Alternative led to the development of the Implementation Plan which identified the next steps in pursuing and negotiating a transfer.

The detailed analysis of existing and potential supply components is presented in Chapter 4, with additional supplemental data in Technical Appendix D.

DEVELOPING AND SCREENING RESOURCE ALTERNATIVES

The goal of the FWSS was to develop potential Resource Alternatives that would meet future demand in both normal and drought years. The District assembled the identified water supply and conservation components, also called building blocks, into Resource Alternatives that could be considered to meet demand in the short, medium, and long term. The Study entailed two rounds of Resource Alternative development, screening, and evaluation. In each round, the most promising components were retained for subsequent analysis, with less promising components eliminated from further consideration during the Study.

To ensure a balanced evaluation process, the District developed a set of criteria against which to evaluate the Resource Alternatives. Criteria focused on four categories—Operational, Economic, Implementability, and Environmental—and were applied to both rounds of Resource Alternatives evaluation. A consistent set of criteria enabled the District to evaluate the Resource Alternatives against established goals, as well as rate an alternative's performance relative to other Resource Alternatives. Based on input from the Board, 12 specific criteria were included in the final list.

In Round 1, the District developed three different Resource Alternative strategies—New Supply, Reclamation and Conservation—consisting of various supply and conservation components. Supply components examined in detail included use of CVP water under the District's contract with the Bureau; use of recycled water (i.e., reclamation); desalination; and surface water transfers from other sources in the Sacramento Valley, the Sacramento-San Joaquin Delta, the San Joaquin Valley, and eastern Contra Costa County. In addition, Round 1 examined the three Conservation Program Alternatives, representing increasingly more aggressive demand management measures.

A preliminary screening of the three Round 1 Resource Alternative strategies revealed several key findings:

- Although existing water supplies will meet normal year demand in the year 2000, the District might experience shortfalls in normal years as soon as the year 2010, and in dry (i.e., drought) years as soon as 2000.
- Even with more aggressive conservation and/or reclamation programs, the District will require a new supply of water during dry years in the near future.
- At current technology levels, the benefits of desalination are outweighed by high energy and construction costs, as well as a lack of flexibility. The desalination component was therefore eliminated from further consideration during this phase

of the FWSS. As technologies are expected to improve, future revisions of the Study should re-examine the potential benefits of desalination

- Although all criteria are important, certain Economic, Operational, and Implementability criteria best distinguish the Resource Alternatives. Therefore, five key criteria were identified and carried forward for further evaluation in Round 2.
- While in the long-term CPA 2 is more cost-effective than CPA 1, CPA 1 was found to be more cost-effective in the near-term and therefore was recommended due to the continuing high level of conservation following the drought.

Carrying forward these and other key findings, the District developed six Resource Alternatives, which were analyzed and screened in greater detail. Round 2 analysis focused on Service Area C (the District's current service area and the planning areas of the raw water customers) and incorporated a more detailed economic evaluation, as well as identifying specific sources of potential transfer water. The goal of Round 2 was to evaluate the Resource Alternatives with an emphasis on life-cycle costs, while also considering the reliability and implementability criteria. The Round 2 screening process helped determine the most promising components to consider when identifying a Preferred Alternative.

The six Round 2 Resource Alternatives varied by assembly of components. All Round 2 Resource Alternatives contained some level of conservation, ranging from 5% (CPA 1) to 12% (CPA 3) by the year 2040. Required surface water transfers ranged from almost zero, to 38,000 ac-ft in a normal year in Service Area C (surface water transfers increased when examining Service Area F). Some of the Resource Alternatives incorporated reclamation projects, whereas others did not. No Round 2 Alternatives included desalination. Present worth costs were calculated which factored in the timing and phasing of the Resource Alternatives' various components, including capital, operating and maintenance costs. Estimated present worth costs for the Resource Alternatives ranged from $265 to $831 million over fifty years.

An evaluation of the six Round 2 Resource Alternatives revealed several key conclusions:

- The Preferred Alternative should be flexible and the Study should be updated at regular intervals.
- CPA 2 was found to be more cost-effective in the long-term, than CPA 1, but CPA 1 is recommended as more cost-effective in the near-term because of its lower near-term costs and the continuing high level of conservation following the drought years from 1987 through 1994.
- Reclamation is more cost-effective as a continuous source than a drought year supply; therefore the need for reclamation arrives as other supplies become inadequate to meet demands.
- Because of its current high capital and O&M costs, reclamation is not recommended in the near-term, but should be re-examined in periodic FWSS updates or as new technology becomes available.
- The current need is for drought supplies to replace CVP shortages, and flexible transfers should be pursued that would meet demands in shortage periods but also possibly be available in the long-term.

THE PREFERRED ALTERNATIVE

A balanced, long-term plan that provides reliability and flexibility is the best solution to the District's need for additional water. The ideal strategy would provide CCWD with supplemental water during drought years, yet allow the District to market surplus supplies during normal and wet years. The Preferred Alternative, therefore, is a resource strategy that allows a mix of components to be implemented over time and includes periodic updates. Being flexible, the Preferred Alternative would present future opportunities to increase conservation and pursue reclamation projects depending on the success of the components, growth in the service area, and/or further reductions in existing supplies.

Rate analysis indicates that implementation of the Preferred Alternative would not result in additional impacts on rates because the current rate structure includes a placeholder of 20 million dollars for the next 10 years for the purchase or transfer of water rights.

Based on the findings of the Round 2 screening, the Preferred Alternative includes:

- Continued reliance on the current contract for CVP water;
- An expanded level of conservation in the near term (5 years), with potentially more aggressive measures in the future (savings estimated for the programs are conservative; CPA 1 is less costly in the short-term and increased savings could potentially be achieved through implementation of CPA 1 without the additional funding required by CPA 2); and
- The simultaneous pursuit of at least six potential surface water transfers as soon as possible.
- Reclamation projects other than those currently being developed will not be pursued in the near-term (5 years), but they will continue to be reexamined as potential sources when the plan is updated.

The Preferred Alternative is expected to be very flexible, implementable, and cost-effective. The detailed analysis of Resource Alternative development and screening is presented in Chapters 5 and 6, with additional supplemental data in Technical Appendices D-F. The District's Implementation Plan was prepared around the Preferred Alternative. Phasing of the plan's components would include both short-term actions to meet immediate demand, as well as long-term flexibility to accommodate future water needs as the customer base continues to grow. The FWSS is designed to be a flexible, "living" planning document, intended for periodic review and updating approximately every five years to respond to future water needs and changing conditions. The Implementation Plan is presented in Chapter 7.

PUBLIC INVOLVEMENT

Although a wide array of water resource options could meet the District's desired goals, any successful strategy must reflect the priorities of the community. Public participation is therefore central to the FWSS planning process, and the District attempted to consider the views of all stakeholders involved. Four methods of public involvement were used:

- Board of Directors' Workshops/Public Forums
- Customer Feedback Group
- Interagency Workshops
- Newsletters

To ensure an adequate level of community input into the FWSS process, the District assembled a Customer Feedback Group in 1994 representing all customer groups within the District, as well as organizations concerned with public policy issues. This group of 25 customers was instrumental in developing a better plan to meet future water needs. The Customer Feedback Group met with District representatives numerous times over the two year Study to review and validate the analytical methodology and help evaluate the Resource Alternatives. The District incorporated comments and concerns of the Customer Feedback Group, which were critical to the identification of the Recommended Preferred Alternative and the success of the overall FWSS process.

The District facilitated the participation of regulatory agencies by forming the Interagency Group in 1994. The Interagency Group was developed to gain the input of planning, resource and regulatory agencies. Three Interagency Workshops were held, aimed at providing information on the Study to various local, State and Federal agencies. The focus of agency participation was to assist in identifying implementation and environmental issues associated with the alternatives.

In addition to the Customer Feedback Group and Interagency Group, the District invited the input of the general public by periodically distributing FWSS newsletters, as well as opening up the Customer Feedback Group and Interagency meetings to all interested parties.

Although the FWSS Report does not have a chapter devoted to public involvement, all stages of the Study process incorporated input from the identified stakeholders. Appendices G and H include a list of members of the Customer Feedback and Interagency Groups, copies of agendas for each of the meetings, and copies of all Board Reports and Presentations.

2. Key Planning Issues and the Evaluation Criteria

OVERVIEW

The Future Water Supply Study (FWSS) was initiated in response to a number of interrelated planning issues that affect the District's ability to meet future water demands. The FWSS provides an integrated approach to assessing the impact of these planning issues on supply and demand, and developing and evaluating alternatives to ensure future demands are met in a cost-effective, environmentally responsible manner. This chapter identifies key planning issues and summarizes the District's methodology in conducting the FWSS, including a discussion of evaluation criteria. Subsequent chapters cover the remaining Study activities, which include assessing demand and supply, developing and evaluating alternatives for meeting future demands, identifying a Recommended Preferred Alternative and preparing an Implementation Plan.

IDENTIFICATION OF KEY PLANNING ISSUES

Key planning issues addressed as part of the FWSS include: (1) the uncertainty of future Central Valley Project (CVP) deliveries, (2) the impact of environmental regulation on water supply, (3) increasing water demands, (4) the role of demand management and alternative supplies in meeting future demands, and (5) meeting demands during drought.

Uncertainty of Future CVP Deliveries

CCWD is a CVP contractor and relies almost entirely on the Federal government (the Bureau of Reclamation) to supply its water through the Sacramento-San Joaquin Delta. The District's contract for CVP water was recently amended. The amended contract with the Bureau of Reclamation (the Bureau) provides for the operation of the Los Vaqueros Project, and for a maximum delivery of 195,000 ac-ft/yr from the CVP, with a reduction in deliveries during water shortages including regulatory restricted and drought years.

Passage of the CVP Improvement Act of 1992 (CVPIA) set new operating parameters for the CVP by reforming water distribution pricing and policies. In effect, the law established the environment as a contractor for CVP water by reallocating 800,000 ac-ft of CVP yield (600,000 ac-ft in dry years) for environmental restoration of Central Valley fisheries and wetlands. The CVPIA set a mandate to better balance the needs of water contractors with those of the environment. As CVP contracts are renewed, water allotments could be reduced to accommodate requirements of the CVPIA. The District's current CVP contract expires in 2010; however, the CVPIA provides for penalties for failure to renew contracts by 1997. Thus, the District may face a reduced CVP supply in the near future, either directly through its contract or indirectly through implementation of the CVPIA.

To meet the 800,000 ac-ft/yr requirement of the CVPIA, future CVP supplies could be reduced by as much as 15 to 20%. If this reduction is spread evenly among the contractors, CCWD could receive as little as 156,000 ac-ft/yr of CVP water during a normal year. Exhibit 2-1 demonstrates the impacts such reductions would have on the District's water supply. The exhibit displays water supply for the District under existing conditions in 1995 on the left, and for future conditions, assuming CVPIA reductions of 15%, on the right. Water supply availability is represented for normal, regulatory restricted and drought years for both current and future conditions.

Though the timing and extent of potential reductions in the District's CVP water supply are uncertain, some reduction is likely. For planning purposes, it is assumed in the FWSS that CCWD's contract could be reduced by 15% upon renewal sometime before 2010.

Supplies during a normal water year include CVP water under existing contract, the District's water rights at Mallard Slough, San Joaquin River diversions made by the District's municipal (City of Antioch) and industrial customers, and miscellaneous other supplies, which include groundwater pumped near the Bollman Treatment Plant in Concord. During a normal year, all these sources could potentially help meet customer demand; total supplies appear to meet demand for the District's existing service area through the year 2020. But given the potential for CVPIA reductions in the year 2010 or sooner, the District could begin to face shortages in supply for its existing service area demand in a normal year in less than 15 years.

The reliability of CVP supplies could be further affected by shortages as a result of drought; potential reductions in entitlements to meet environmental needs in addition to those defined in the CVPIA; potential future changes in contract shortage provisions; and the risks associated with transferring water through the Delta (e.g., levee failure or flooding).

CVP Contract Shortage Provisions. The full amount of the District's CVP contract may not be available in all years due to regulatory restrictions on deliveries or due to drought. The contract defines methods for determining how much water CCWD would receive under different shortage conditions.

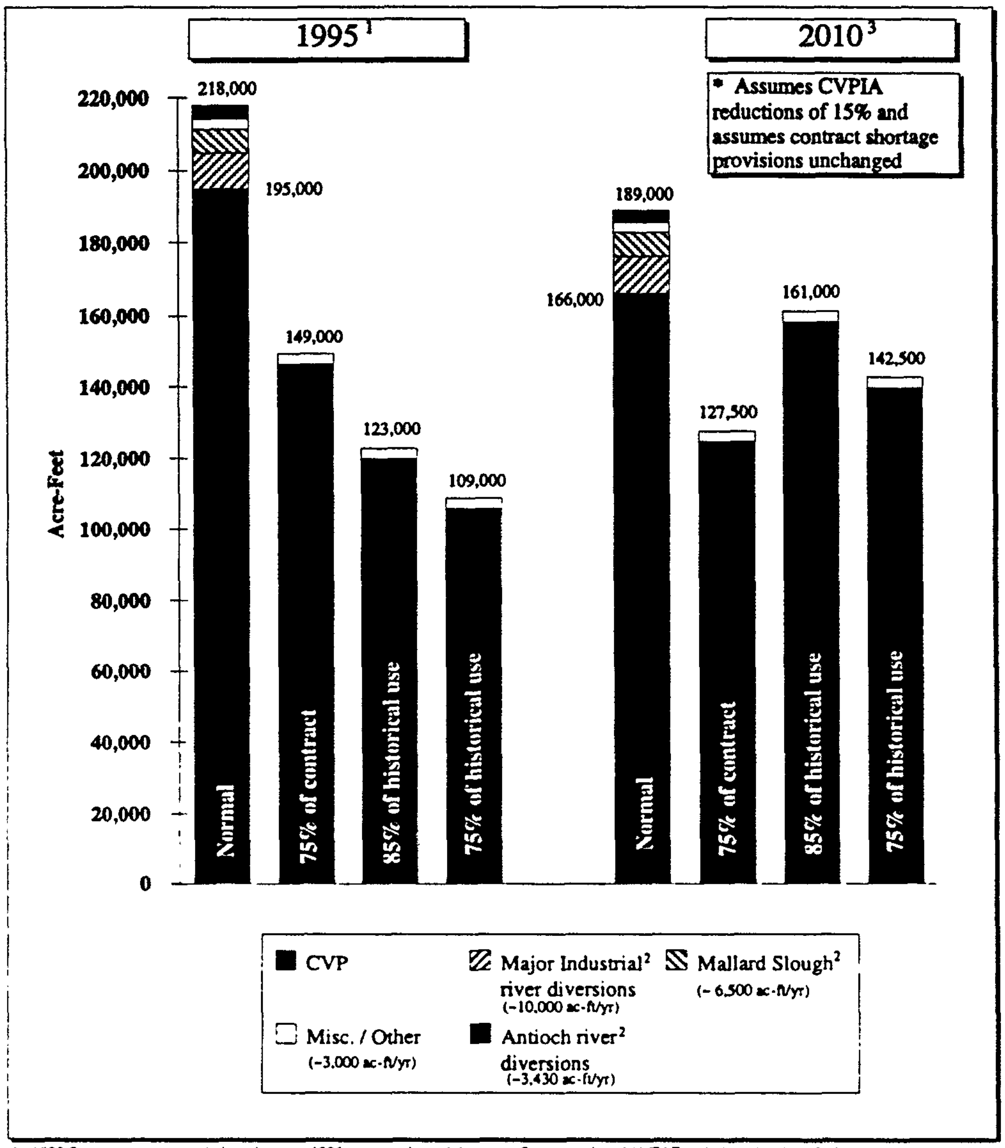
When regulatory restrictions exist, the District's supply can be reduced to the greater of 75% of contract entitlement, or 85% of historical use. Regulatory restrictions could occur as a result of hydrology, as well as environmental requirements such as diversion restrictions or water releases for fish and wildlife uses. In a drought year, currently estimated to occur with a frequency of one year in seven, the Bureau can reduce the District's CVP water to the lesser of 75% of the contract amount or 85% of historical use, but in no event less than 75% of historical use (the latter floor can be allocated in extreme droughts).

In dry conditions when CVP supplies are likely to be reduced, it is common for diverters to reduce Mallard Slough and San Joaquin River supplies due to high salinity levels. These diversions are replaced with diversions from the Contra Costa Canal, increasing demand on the District's diminished supplies. Given this phenomenon, supplies available to the District during both regulatory restricted and drought years are currently insufficient to meet the demand of existing customers.

The Impacts of Environmental Regulation on Supply

The CVP and the State Water Project (SWP) together divert approximately 6 million ac-ft of water from the Delta each year. Concerns over the Delta's health and recent regulatory activities make the future of water diversions from the Delta uncertain. These

Exhibit 2-1
Water Supply Under Existing and Potential Future Conditions



1. 1995 figures are an example based upon a 1995 growth adjusted diversion figure, totaling 141 TAF including the clean fuels program.
2. Antioch and Mallard diversions are an average based on the years 1984,1986 and 1993. Major Industrial diversions are an estimate based on historical use.
3. 2010 figures are based upon a diversion figure of 186 TAF including CVP supplies, Major Industrial, Antioch and Mallard Slough river diversions.

CVP Contract Shortage Provisions

Regulatory Restricted Year = The **Greater** of 75% of Contract (195 TAF) or 85% of Historical use based on an average of the last 3 years unaffected by shortage.
Drought Year = The **Lesser** of 75% of Contract (195 TAF) or 85% of Historical use, but not less than 75% of Historical use.

Note: Normal year bars show total supplies available.

activities could result in restrictions on the timing or quantity of diversions from the Delta, thereby limiting the ability of water providers to meet the needs of their customers. In addition to the CVPIA, major regulatory activities that could affect future CCWD diversions from the Delta include the Endangered Species Act of 1973 (ESA) and the Clean Water Act of 1972 (CWA). The United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) have jurisdiction and permitting authority under the ESA, and the U. S. Environmental Protection Agency (EPA) retains the authority for setting water quality standards through the CWA. All future strategies for meeting the District's future water demands will have to be evaluated in light of these regulations.

Endangered Species Act of 1973. The Federal ESA prohibits any action likely to harm, cause injury to, or disrupt the normal behavior pattern of any species listed as threatened or endangered. The USFWS has the authority to implement protection for most species under the ESA, while NMFS has jurisdiction for protecting anadromous fish (such as salmon). Two fish species in the Delta have recently been listed under the ESA: the winter-run chinook salmon (anadromous) and the Delta smelt. A third species, the Sacramento splittail, was proposed for listing in 1993.

A series of biological opinions has been issued covering operations of the CVP, the SWP and the Los Vaqueros Project. The most recent biological opinions for the CVP and SWP found that project operations for actions in the Delta were not likely to jeopardize the continued existence of winter-run chinook salmon and Delta smelt, provided they abide by the December 15, 1994 Principles for Agreement operational restrictions. The biological opinions for the Los Vaqueros Project which also covers CCWD operations were "non-jeopardy" opinions, indicating the project would not jeopardize the continued existence of these two listed species (the opinion on Delta smelt also covers Sacramento splittail, should it be listed in the future). However, the District and the Bureau will be required to re-consult with USFWS at the time CVP deliveries to the District reach 148,000 ac-ft/yr.

If Sacramento splittail are listed as threatened or endangered, or if any other species are proposed for listing in the future, additional protection measures may be required. Such uncertainty could significantly affect the Bureau's, and in turn CCWD's, ability to divert the full contract amount of water from the Delta.

Clean Water Act of 1972. The State Water Resources Control Board (SWRCB) has set flow and salinity standards for the Delta since the 1960s. In 1978, the SWRCB adopted Decision 1485 (D-1485), setting standards to be periodically reviewed and revised. In 1987, the SWRCB began proceedings to revise D-1485 under the Racanalli Decision which found D-1485 to be inadequate. In May 1991, the SWRCB adopted a plan for the Delta that addressed temperature, salinity and water quality standards for the estuary, but did not include any increases in fresh water flows to meet those standards. In September 1991, using its authority under Section 303(c)(3) of the CWA, the EPA rejected the plan. This rejection was based on the absence of sufficient criteria (particularly salinity standards) to protect estuarine habitat and other fish and wildlife uses of the Bay-Delta.

In 1993, after failure of the SWRCB to adopt interim standards included in the Draft Water Rights Decision D-1630, the EPA began to develop Federal water quality criteria for the Bay-Delta (including publication of a Proposed Rule). These Federal standards were finalized in January 1995 (Federal Register January 24, 1995). However, these standards were affected by a recently signed joint Federal/State agreement and are being withdrawn.

On December 15, 1994, the State and Federal governments and other interested parties (including urban, agricultural and environmental interests) signed an agreement regarding Bay-Delta water quality standards—"Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government." The agreement includes water quality and flow standards as well as commitments regarding future listings under the ESA and non-flow factors. Also on December 15, 1994, the SWRCB released a Draft Water Quality Control Plan. This plan is based on the Principles for Agreement and while the water quality standards in the plan differ from EPA's standards, the EPA as a signatory to the Principles for Agreement has accepted the plan and has agreed to withdraw the Federal standards.

Upon adoption of the State's Water Quality Control Plan in May 1995, the SWRCB initiated water rights hearings to implement the plan, which includes providing additional fresh water flows into the Delta. The water rights proceedings are expected to take three years. In the interim period, the State and Federal governments have agreed to provide all necessary fresh water flows to meet the established water quality standards through re-operation of the CVP and SWP. The two projects have begun to operate in accordance with the Principles for Agreement and obtained from the SWRCB the necessary revisions to their water rights (Water Right Order 95-06).

Implementation of the Water Quality Control Plan will affect water supply in the Delta, but the specific impacts of the Agreement on water supplies are uncertain at this time. Strategies developed to meet future demands must take this uncertainty into account.

Increasing Water Demand

CCWD water demand has increased over time due to population growth and new development within the District's existing and expanding service area. How these factors will influence future water demand is a threshold question of the Study.

Population Growth and New Development. Water demand is based primarily on water use factors and land use (or population). Land use within the CCWD Service Area is guided by city and County land use plans, which usually have a planning horizon of 15 to 20 years. The FWSS has a 50-year planning horizon. Projecting water demands for the full study period required estimating growth beyond existing land use plans. Such long-range estimates require assumptions about the rate, pattern and density of future development and population and household characteristics. Because of the uncertainty associated with demand based on such assumptions, demand has been expressed as a range, with the range increasing over time.

Demand by Non-District Customers. Significant new development is planned for East Contra Costa County outside the District's current service area. Most of this area depends on groundwater to meet municipal and industrial (M&I) water needs. However, the long-term reliability of groundwater in the region is limited due to water quality problems and uncertain sustainable yield. Thus, additional supplies will be needed to meet future demand. The East County Water Management Association is studying alternative sources and infrastructure needs in the East County Water Supply Management Study - Phase II.

Implementing water supply alternatives in East County could involve expanding the District's service area to include all or part of East County. The focus of the FWSS is on meeting future demand within CCWD's Sphere of Influence (SOI) and the planning areas of existing raw water customers, but it also includes analysis of how new areas could be served if the District were called upon to do so. The purpose of this analysis is to ensure that water supply options for the expanded area are not precluded by decisions for the smaller area, and to determine whether implementing alternatives for an expanded area might increase benefits in all areas. Including areas outside the District's boundaries in the FWSS does not signify an intent to serve those areas.

The Role of Demand Management, Reclamation and Water Transfers in Meeting Future Demand

Until the FWSS, CCWD independently developed water conservation, reclaimed water and surface water supply plans and programs. This Study provides the opportunity to evaluate alternative ways of meeting future demand in the context of an overall water supply plan. A comprehensive approach facilitates District decisions on the level and timing of future investments in each component.

Conservation. Conservation has played an important role in managing demand within the District's service area in both normal and drought years. The District is signatory to the California Urban Water Agencies Best Management Practices (BMPs) Memorandum of Understanding (MOU). Elements of the existing program include water audits, distribution of water savings kits, plumbing retrofit incentives, public information and school education programs, leak detection and repair, water metering and meter testing, canal rehabilitation and conservation pricing. Conservation is a component in all the Resource Alternatives developed to meet future demands. The nature and extent of future conservation programs depend on the costs and benefits of conservation compared to other supply components and the potential effects of demand hardening which can diminish the ability to achieve savings over the long-term.

Conservation program analysis in the FWSS includes estimating the costs, quantity saved and reliability of specific conservation measures and then grouping the measures to achieve different levels of savings over several time periods. Savings estimates assume that conservation programs are applied consistently throughout the District's service area. It is also assumed that some conservation will occur irrespective of any formal programs by the District or its wholesale customers due to State regulations and local ordinances.

Reclamation. Several of the District's planning studies on reclamation have identified opportunities to augment surface water supplies with reclaimed water in the service area. The District has also entered into an agreement with Central Contra Costa Sanitation District (CCCSD) establishing a process for developing future reclaimed water projects. Reclaimed water was also used in the 1991 dr ught to reduce demand on CVP supplies. Due primarily to high initial costs and subst ntial lack of benefit in times of shortage, the District has not developed permanent reclaimed water projects. When evaluated over time and in the context of the costs and benefits of other water supplies, these parameters may change. The FWSS provides the analysis necessary to determine when different types of reclaimed water projects may become viable alternatives. Although reclamation is more cost-effective as a continuous source, rather than a drought supply and near-term costs are high, this component will continue to be reexamined as a potential source, when the Study is updated (approximately every five years), and/or as new technology becomes available.

Water Transfers. The District has participated in the State Water Bank on several occasions and has had discussions with various water agencies on purchasing excess supply. Before committing to a long-term transfer, the District needed to evaluate the reliability, availability and costs of such transfers in light of evolving water rights and Bay-Delta regulations, and in comparison to reclaimed water and demand management options. The FWSS evaluates a large number of additional supply sources that could potentially be transferred to the District. These range from local sources within the County to those as far north as Shasta County. Groundwater export, conjunctive use and surface water storage are also examined.

Meeting Demand During Drought

Drought periods present special circumstances for the District--demand is typically increased while supplies are decreased. Policy issues associated with these circumstances include how much additional water to provide, how far to reduce demand, and how to distribute the costs of meeting drought period demand. In past drought years, the District has implemented water bank purchases (transfers), voluntary and mandatory water reduction programs and excess use charges to address short-term supply shortages. The FWSS identifies alternatives for meeting drought period demand and analyzes the interrelationship between short-term strategies and long-term supply alternatives. It is assumed in the Study that the District would meet a minimum of 85% of demand through a combination of long-term conservation and developed supplies during drought periods. This assumption is consistent with performance of CCWD customers during previous droughts.

EVALUATION CRITERIA

The evaluation criteria played a central role throughout the entire FWSS process. Evaluation criteria were defined to ensure that key planning issues were addressed and recommendations of the Study are consistent with the mission of the District to "strategically provide a reliable supply of high quality water at the lowest cost possible in an environmentally responsible manner." The criteria presented in Technical Appendix B and summarized below, were developed as goals of the Study, and used to evaluate the Resource Alternatives to define how well these goals are achieved. The criteria were applied at several stages of Resource Alternative development. Resource Alternatives, or components of Alternatives, that best meet the goals of the Study moved into the next stage; others were eliminated from further study in the context of the FWSS. This approach to screening produced a manageable number of viable Resource Alternatives while allowing flexibility in the final product. Technical Appendix B contains a detailed description of each evaluation criterion, including the factors used to evaluate the Resource Alternatives and definitions of High, Medium or Low ratings.

Evaluation Criteria (Final)

O1 **Minimize** water **shortages** (frequency and amount)
O2 Maximize water **system reliability**
O3 Maximize the **quality and treatability** of source waters

Ec1 Minimize **life-cycle costs**
Ec2 Minimize **rate impacts** to customers
Ec3 Minimize **indirect economic impacts** to customers

En1 Minimize environmental impacts to **aquatic habitat** (including threatened and endangered species)
- upstream
- in the Delta
- at the point of diversion

En2 Minimize environmental impacts to **special status terrestrial species and wetland resources**
En3 Minimize impacts to **the community**

I1 Maximize the **seniority of water rights**
I2 Minimize **institutional barriers** and risk of delay
I3 Ensure proper **timing and phasing**

Note: **Bolding** represents key words or phrases by which each criterion may be referred to in future charts, etc., as the Study progressed into the screening and evaluation process.

THE NO ACTION ALTERNATIVE

The No Action Alternative is the District's option to not implement any additional demand-side or supply-side resources. The No Action Alternative was reviewed in terms of the evaluation criteria. It would result in significant and adverse impacts and would result in CCWD not meeting the goals and mission identified at the beginning of the FWSS: "to strategically provide a reliable supply of high quality water at the lowest cost possible in an environmentally responsible manner." Potential impacts of the No Action Alternative include projected shortages of water for the District's customers and adverse socioeconomic impacts.

In the short term, the conditions under the No Action Alternative would be the same as existing conditions described in Chapter 4, with the District requiring additional supplies during drought years only, and under certain conditions during regulatory restricted years. Long-term conditions would change as described below.

- The availability of the District's primary supply source, the CVP allotment, would continue to diminish due to regulatory restrictions or water supply shortages.
- Drought deficiencies would continue to be incurred by CVP municipal and industrial water contractors, including CCWD, in one out of every seven years.
- The number of the District's customers will continue to increase.
- Reduced supplies and resulting decreased sales would likely force the District to raise rates and charges.
- The significant, recurring shortages would cause economic loss due to dying landscapes and impacts on water-dependent business.

In the long term, the frequency and severity of shortages could continue to increase due to increasingly stringent regulatory conditions in the Delta and increasing demand for CCWD water supplies. It is estimated that customer shortages during normal water years would reach 25%; drought year customer deficiencies could reach 35%. It is important to note that these are District-wide reductions. Impacts on residential customers would be significantly higher. For example, a 25% District-wide reduction would necessitate over a 35% reduction by single-family residential customers. The potential negative impacts associated with the No Action Alternative do not warrant its further consideration in this analysis.

STUDY METHODOLOGY

The study methodology for the FWSS includes six major sections: (1) project initiation; (2) definition of Service Areas and projecting demand; (3) definition of conservation components; (4) definition of supply components; (5) screening of components and development of Resource Alternatives; and (6) screening of Resource Alternatives. Two other integral components include report preparation and development of the communications plan. The planning methodology for carrying out the Study is depicted in Exhibit 2-2.

Project initiation, Section 1 of the FWSS methodology, included the review of existing plans and studies, the identification of key planning issues, the confirmation of planning goals, and the development of evaluation criteria for the Study. Section 2 encompassed the mapping of the six service area alternative boundaries, review of past consumption data, identification of the mapping and data integration effort, preparation of preliminary demand projections for each of the service areas and a sensitivity analysis of those demands. Section 3 entailed the preparation of savings estimates attributed to the District's existing conservation plan and the development of a full range of long-term conservation programs of increasing intensity.

Section 4 of the methodology included the definition and evaluation of existing resources for the District, the description of a wide range of potential supply components, a review of water rights and institutional issues identified for the components, definition of the transfer pathways and quantification of streamflow changes, definition of potential conveyance needs necessary to transport water from potential sources, and definition of any in-District facility needs necessary to accommodate such changes. Section 5 involved the screening of components, development of Resource Alternatives, and the definition of facility needs and present worth costs for each Resource Alternative. Section 6 included assessment of environmental and institutional implications, comparative ranking of the Resource Alternatives, development of rate impacts, and identification of the Recommended Preferred Alternative.

The FWSS Report preparation was directly tied to the preparation of Technical Memoranda (TM), which were written as a result of each task or combination of tasks within each section of the Study. The Technical Memoranda were conceived as works-in-progress and designed to be refined into Chapters of the FWSS Report as the study progressed through each section. Major products included TM 1.3 discussing the goals and criteria for the study, TM 2.3 outlining the preliminary demand estimates for the Service Areas, TM 3.2 defining the range of conservation programs for evaluation, TM 4.3 defining the range of supply opportunities, TM 4.6/5.4 describing the facility needs and present worth costs for the Resource Alternatives, TM 5.3 outlining the component screening and assembly of components into Resource Alternatives, TM 5.5 analyzing the potential rate impacts of the Resource Alternatives, TM 6.2 summarizing the evaluation of the Resource Alternatives and TM 6.4 describing the identification of the Recommended Preferred Alternative.

The FWSS communications plan included four levels of communication aimed at creating a variety of forums for meaningful participation and input among the public, various customer groups, interested agencies and elected officials throughout the FWSS process. The four levels of communication are:

- Board of Directors' Workshops/Public Forums
- Customer Feedback Group
- Interagency Workshops
- Newsletters

Board workshops were scheduled addressing each of the six sections of the FWSS process. The intent was to facilitate two-way communication between the public and the CCWD Board of Directors, and for staff to receive policy direction and guidance from the Board. The fifth Board Workshop also served as a public forum for interested parties to comment on the Resource Alternatives.

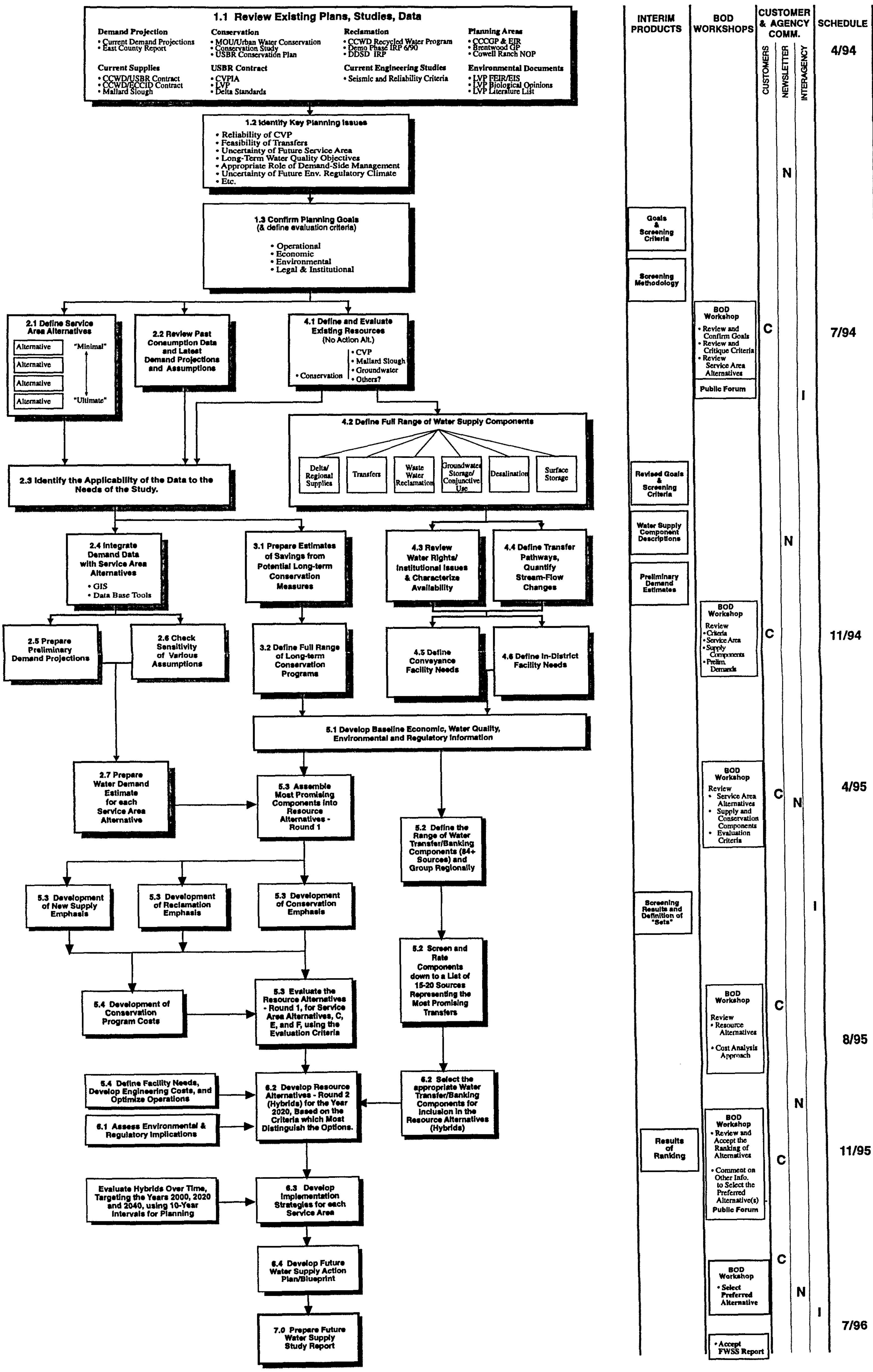
The role of the Customer Feedback Group is to provide comments and feedback on the FWSS issues.

The Customer Feedback Group was assembled to provide an educational forum and provide feedback from the District's municipal, industrial and commercial customers and key policy makers. The Customer Feedback Group meetings were held previous to each Board workshop to provide the Board with immediate feedback from the group on each presentation. Newsletters were prepared to ensure a clear understanding of the Study, major tasks, decision points and key recommendations throughout the process. Five newsletters were prepared and distributed during the two-year Study to a broad base of key customers throughout the service area. Three Interagency Workshops were held, aimed at providing information on the Study to various local, state and federal agencies. Technical Appendices G and H (TA-G and TA-H) provide more detailed information on materials prepared for and as a result of the communications plan.

REPORT FORMAT

The chapters in this report correspond to the study methodology of the FWSS. The first chapter is an overview summarizing the key findings of the Study. Chapter 2 describes the key planning issues as discussed in Section 1 of the Study methodology. Chapter 3, the Need for Water, describes demand projections for each of the Service Areas. Chapter 4, Meeting Water Needs, describes the potential conservation programs and supply sources for future implementation. Chapter 5 describes the screening of components, and the initial assembly and evaluation of Resource Alternatives. Chapter 6 details the screening of Resource Alternatives and selection of the Preferred Alternative, and Chapter 7 outlines the Implementation Plan. A series of eight Technical Appendices (A-H) provide finer detail to assist the reader in a greater understanding of the overall FWSS process and backup material to the decision-making process.

Exhibit 2-2
CCWD Future Water Supply Study
Planning Methodology



3. The Need for Water

OVERVIEW

As future demand drives "how much supply" is needed, a key component of the FWSS is projected demand levels. Demand forecasts, which were used to estimate the future need for water, are based on several variables: the size of the service area; the rate, pattern and density of growth; land development potential; future land use types and water consumption by land use; population characteristics; and water use habits. Determining what areas will be served and how each variable will change over time requires making estimates based on current data and trends. Developing and working with alternative future service area scenarios that bracket the range of possible future demand projections provides the opportunity to explore a logical array of demand values. These values can then be evaluated against alternative supply and conservation opportunities. Examining different service area scenarios allows identification of the significance of service area changes on the adequacy of supplies; this examination, however, is not an endorsement of any specific scenario.

The key parameter for addressing future demands within this Study was to focus on aggregate demand for each Service Area.

Six Service Areas were examined to determine a logical array of demand levels and their geographic distribution. Average annual demand was determined for each Service Area by first reviewing historical data, and then determining the appropriate components to be used in projecting future demand for Residential, Major Industrial and other Non-Residential demands. Exhibit 3-1 illustrates the approach to developing demand projections. This chapter provides a summary of the development of demand projections; further details are provided in Technical Appendix A. Demands were calculated for the Service Areas. In wet years, some Service Area demands are met by water supplies separate from those of CCWD. This means that wet year CCWD demands are lower than average Service Area demands, and reliance on CCWD supplies increases dramatically in dry years (even if Service Area demand is constant).

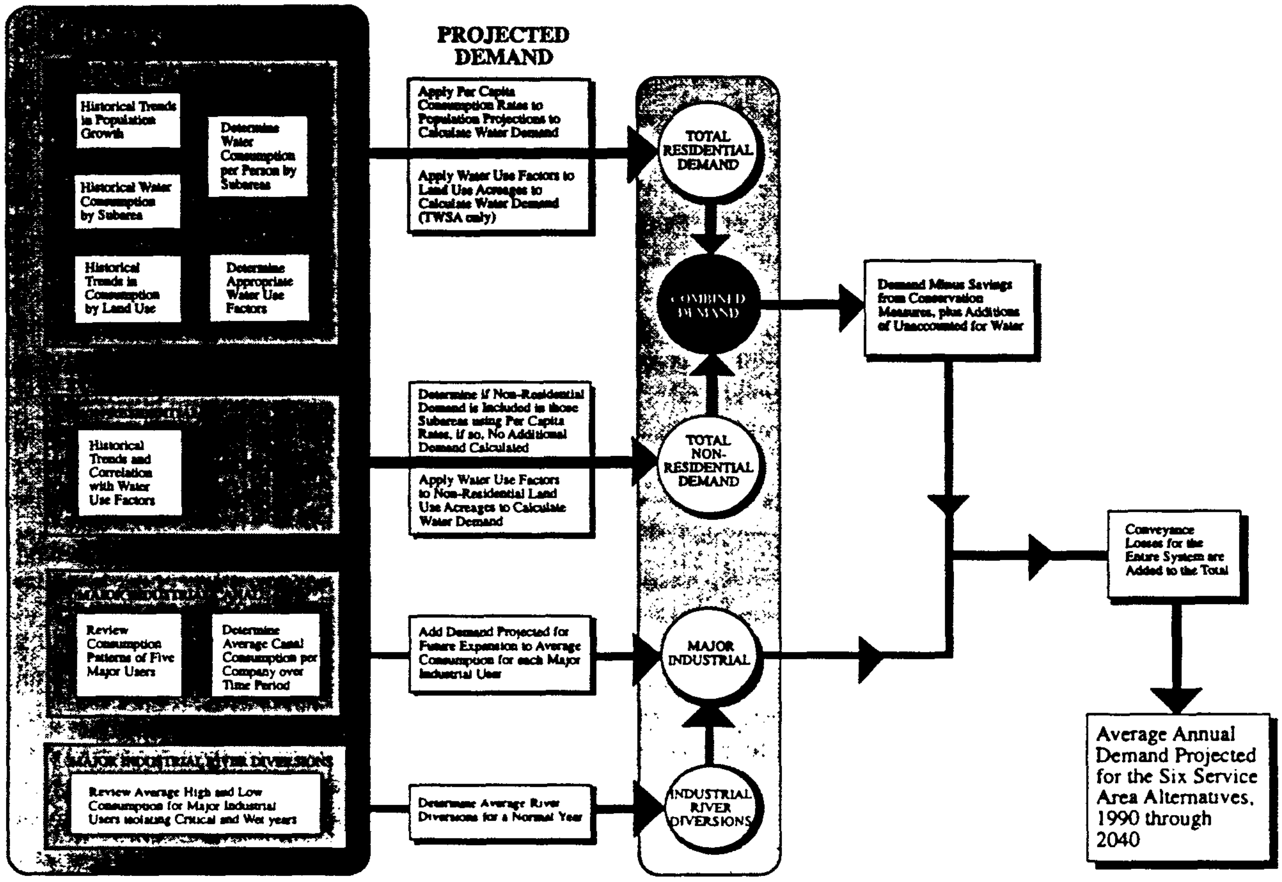
SERVICE AREA DEFINITIONS

The six Service Areas, displayed in Exhibit 3-2, were defined geographically for planning purposes; they provide the opportunity to explore a logical array of demands and their geographic distribution and do not represent the District's intent to serve any particular geographic area beyond the current boundaries. The six Service Areas are cumulative and build upon each other (for example, Service Area B includes Service Area A). They can be characterized as follows:

- **Service Area A** - Los Vaqueros Planning Area (plus minor annexations to June 1994): This Service Area includes Antioch, Bay Point, Clayton, Clyde, Concord, Martinez, Oakley, Pacheco, Pittsburg, portions of Pleasant Hill, Port Costa, portions of Walnut Creek and unincorporated areas of Contra Costa County.
- **Service Area B** - CCWD Sphere of Influence[1], including Diablo Water District's (DWD) Sphere of Influence: This Service Area includes Service Area A plus Hotchkiss Tract, Veale Tract, Knightsen and additional portions of Oakley.

1 A Sphere of Influence (or SOI) is an area defined by cities and special districts to indicate the logical areas for growth extending into adjacent unincorporated areas, as approved by the Local Agency Formation Commission (LAFCO).

Exhibit 3-1
Demand Approach



- **Service Area C** - Service Area B *plus* DWD Planning Area: This Service Area includes Service Area B plus Bethel Island, portions of southern Oakley, and other unincorporated lands outside of the Urban Limit Line[2].
- **Service Area D** - Service Area C *plus* Brentwood Planning Area: This Service Area includes Service Area C plus unincorporated lands inside and outside of the Urban Limit Line (ULL).
- **Service Area E** - Service Area D *plus* General Plan buildout in East County: This Service Area includes Service Area D plus Discovery Bay, Cowell Ranch, Byron, East County Airport and other unincorporated lands inside and outside of the ULL.
- **Service Area F** - Service Area E *plus* East County "Combination" scenario: This Service Area refers to the *Phase I East County Water Supply Study*, which assumed a densified General Plan buildout, as well as expanding suburbanization. This Service Area includes Service Area E plus remaining unincorporated lands within the county, all of which lie outside the ULL. For those areas outside the ULL, growth has been assumed to occur after the year 2010, when Measure C would expire. The agricultural core has been excluded from any assumed future development.

2 The Contra Costa County Urban Limit Line (ULL), "... affirmed by the voters in their adoption of Measure C (1990), is an integral feature of the Contra Costa County General Plan Land Use Element. The purpose of the ULL is two-fold: 1) to ensure preservation of identified non-urban, agriculture, open space and other areas by establishing a line beyond which no urban land uses can be designated during the term of the General Plan, and 2) to facilitate the enforcement of the 65/35 (non-urban/urban) Land Preservation Standard." (*Contra Costa County General Plan*, page 3-14)

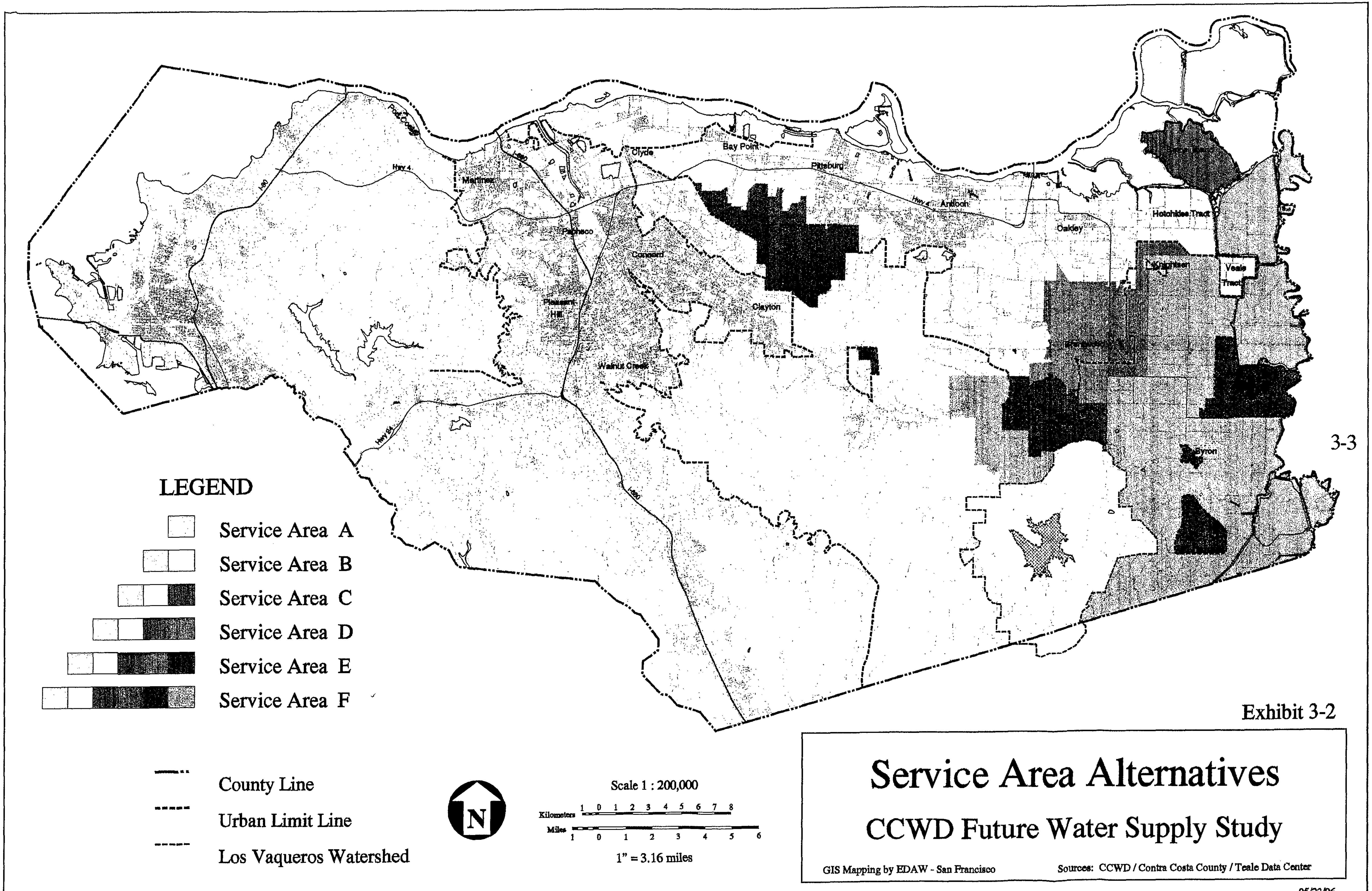


Exhibit 3-2

Service Area Alternatives

CCWD Future Water Supply Study

GIS Mapping by EDAW - San Francisco

Sources: CCWD / Contra Costa County / Teale Data Center

05/23/96

C-099969

DEMAND PROJECTIONS

Demand projections in the FWSS are based on estimates of future land use changes and population growth. They represent the corresponding growth in water demand associated with land use and demographic changes, as calculated through the application of water use factors (WUFs) or per capita consumption rates. Demand levels were calculated irrespective of the source of supply.

Average annual demands in ac-ft for each Service Area were projected by decade from 1990 to 2040. The base year 1990 was selected to correspond with the 1990 census data. The year 2040 was selected as the horizon year for two important reasons. First, the District's current CVP contract expires in 2010. The contract could be renewed for 25 more years, which would carry the renewal to the year 2035. Using the year 2040 ensures ample time to accommodate the CVP contract period. Secondly, water projects in the current regulatory environment need extensive lead times, beginning with planning, design and permitting, through construction and implementation. A long planning horizon allows short-term measures to be integrated with long-term alternatives in a cost-effective manner. Regular reviews of the FWSS will allow updates or modifications as required by changing future conditions.

Although demands were calculated for smaller subareas within each Service Area, the planning purposes of this Study focussed on issues of overall supply and demand. Therefore, the key parameter was to address aggregate demand for each Service Area.

The development of demand projections, including historical consumption data and study methodology, is summarized below.

Historical Consumption

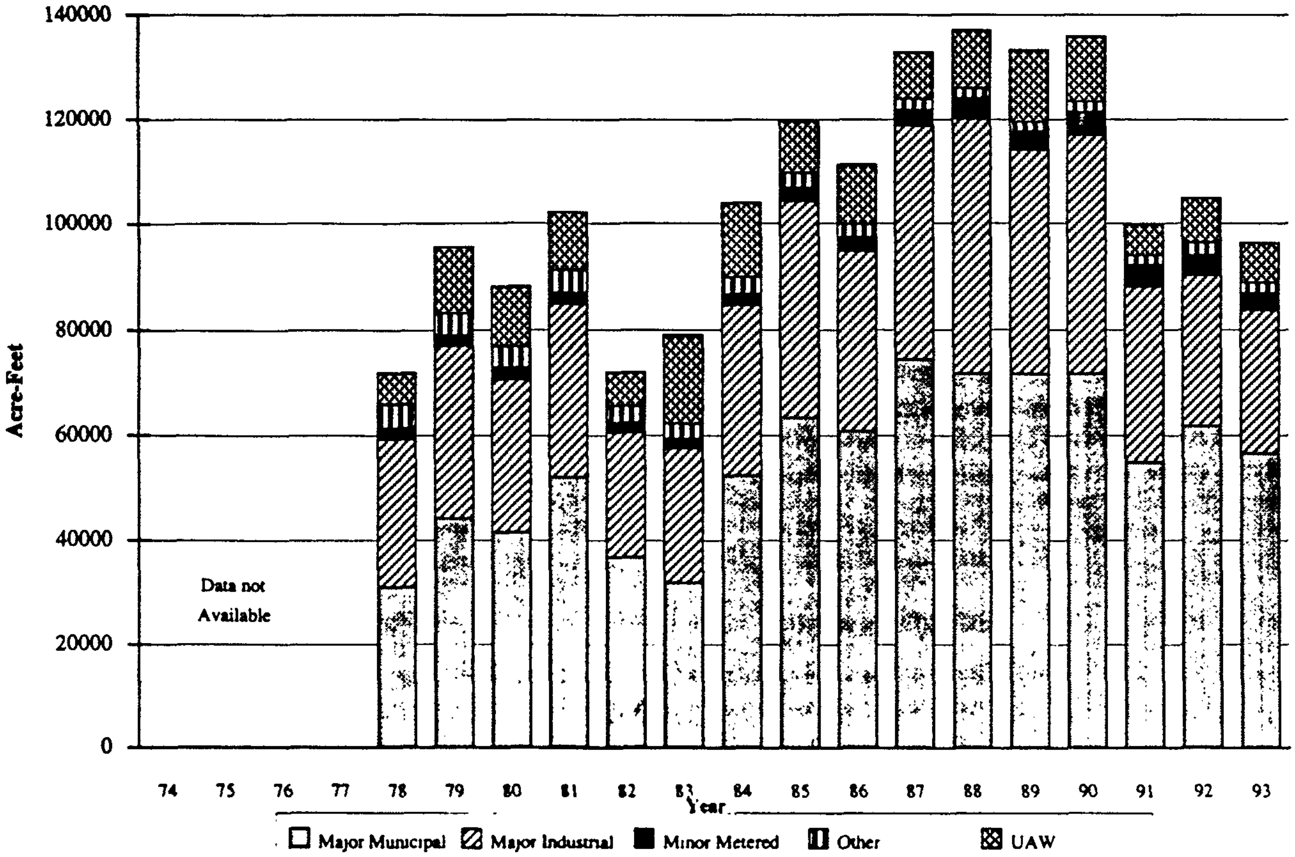
The most valuable source of the District's past consumption data has been the historical production measured at Pumping Plant No. 1 and sales figures for major customers. Water withdrawn from the Delta through the intake channel at Rock Slough to Pumping Plant No. 1 is distributed to raw water customers and the District's Treated Water Service Area (TWSA). Regularly collected measurements at CCWD's Pumping Plant No.1 indicate water pumped into the Canal for use within the District's present service area. Although data from other supply sources such as the District's water rights at Mallard Slough, wells at the Bollman Treatment Plant (Mallard well fields) and elsewhere in the District, and river diversions by others are useful and essential to the analysis, data for Pumping Plant No. 1 are most representative for obtaining a reasonable understanding of the overall water demand within the District's service area.

The historical record used for the FWSS was 1974-1993.

The 20-year period, 1974 to 1993, was selected as the most representative and comprehensive period for presenting historical data; the period is sufficient to develop assumptions for demand projections, as well as for other concerns such as conservation savings estimates, seasonal variations and water-year type adjustments. Some consumption data were not available for all years (the period 1974-1977), in which case only a 16-year period was used.

During the historical period, 1974-1993, production at Pumping Plant No. 1 has ranged from approximately 72,000 ac-ft/yr (1978 and 1982) to a peak of approximately 137,000 ac-ft in 1988. Since the data analysis was performed, the last two years have also fallen within the historical range, with annual pumping of approximately 110,000 ac-ft and 95,000 ac-ft in the years 1994 and 1995, respectively. Water sales from the Contra Costa Canal were aggregated into four major categories defined as Major Municipal, Major Industrial, Minor Metered and Other Groups. Exhibits 3-3 and 3-4 show the largest category over the period 1978-1993 to be the Major Municipal, with customers

Exhibit 3-3
Water Production and Sales by Major Customer Group at Plant No. 1 (acre-feet)
1978-1993



Source: See Exhibit 3-4

located in the TWSA, and the Raw Water Service Areas (RWSA) of Antioch, Bay Point, Martinez, Pittsburg and the Diablo Water District. Major Municipal customers received more than half of the water produced at Pumping Plant No. 1 or Mallard Slough during the period. Major Industrial customers such as Shell Oil, Tosco Oil, USS-Posco and Gaylord Container received about a third of the total production, with less than 6% going to Minor Metered and Other uses. The remaining 10% is unaccounted for water (UAW).

In addition to production at Pumping Plant No. 1, other supplies have been measured including local supplies (groundwater pumped from wells adjacent to the Bollman Water Treatment Plant) and municipal (Antioch) and industrial river diversions. Exhibit 3-5 and its accompanying data table, Exhibit 3-6, illustrate Pumping Plant No. 1 *pumpage* as a portion of historical water supplies for the 20-year period. Pumping records for Mallard Slough indicate the wide range experienced by the District in year-to-year diversions due to water quality fluctuations in the Delta. Recent District records for Mallard Slough, showing 0 ac-ft and 9,044 ac-ft for the years 1994 and 1995, respectively, continue to reflect a wide range. Total supplies during the period have ranged between 84,000 ac-ft in 1978 to a high of over 148,000 ac-ft in 1988.

C-099971

Exhibit 3-4
Water Pumpage and Sales by Major Customer Group at Plant No. 1 (acre-feet)
1974-1993

Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Plant No. 1 Pumpage	78,446	76,756	125,118	95,567	71,757	95,508	88,130	102,181	71,867	79,017
Unaccounted					5,925	12,287	11,241	10,969	6,375	16,791
Percent Unaccounted					8.3%	12.9%	12.8%	10.7%	8.9%	21.2%*
Annual Water Sales					65,832	83,222	76,889	91,212	65,492	62,226
Major Municipal					30,939	44,040	41,408	52,233	36,771	31,956
Major Industrial					28,305	32,956	29,100	32,666	23,706	25,604
Minor Metered					2,143	1,994	2,264	2,023	1,781	1,762
Other					4,444	4,232	4,117	4,290	3,234	2,904

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Plant No. 1 Pumpage	103,929	119,644	111,337	132,799	136,864	133,224	135,733	99,870	104,926	96,284
Unaccounted	13,957	9,767	11,456	8,821	10,809	13,666	12,254	5,832	8,616	7,324
Percent Unaccounted	13.4%	8.2%	10.3%	6.6%	7.9%	10.3%	9.0%	5.8%	8.2%	7.6%
Annual Water Sales	89,972	109,877	99,881	123,978	126,055	119,559	123,479	94,038	96,310	88,960
Major Municipal	52,440	63,282	60,759	74,377	71,618	71,648	71,610	55,034	61,807	56,649
Major Industrial	32,275	41,132	33,969	44,387	48,448	42,474	45,394	33,124	28,495	27,093
Minor Metered	1,949	2,576	2,608	3,101	3,969	3,527	4,406	3,983	3,664	3,194
Other	3,309	2,886	2,545	2,113	2,020	1,909	2,069	1,897	2,345	2,024

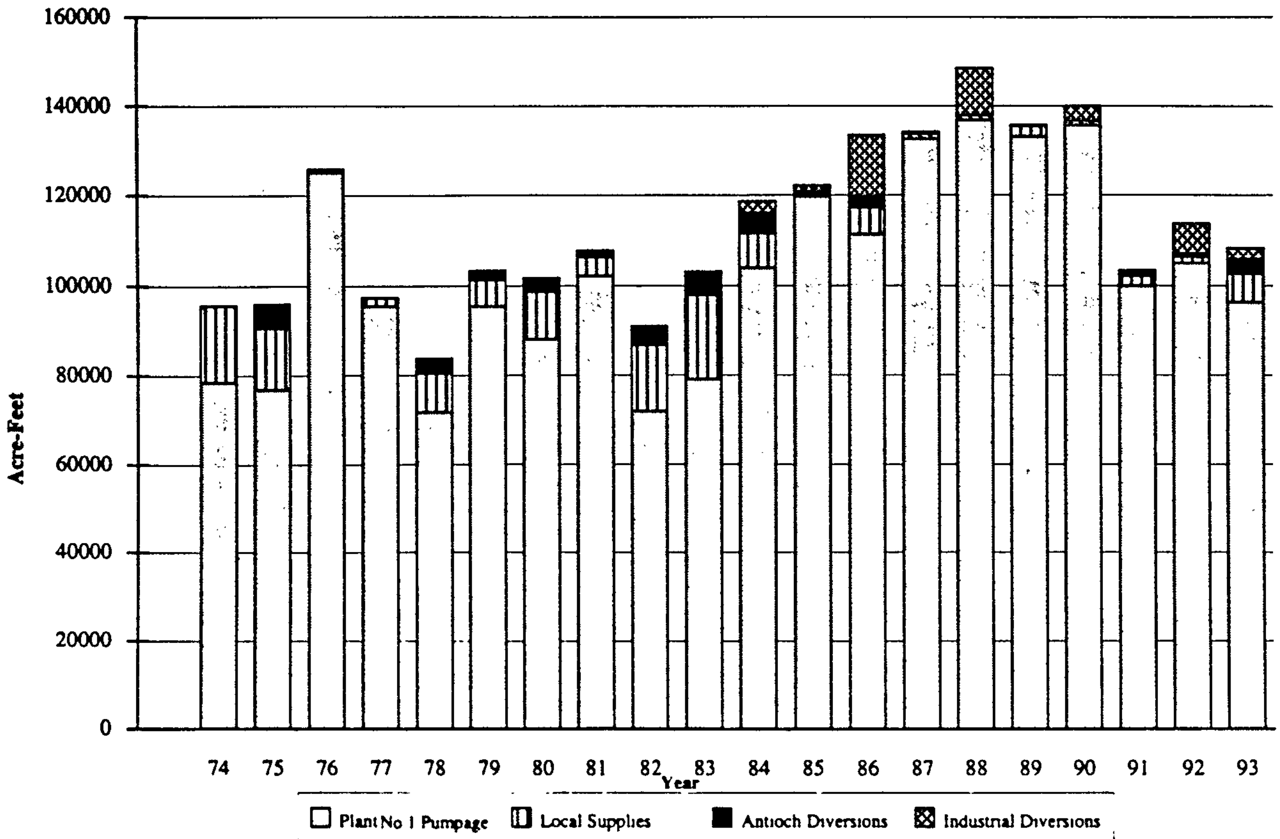
Notes and Sources:
Plant No. 1 Pumpage, 1974 to 1993: CCWD O&M Dept., Contra Costa Canal (monthly) Water Supply History
Annual Water Sales data by Customer Groups, 1974 to 1977 are not available
Annual Water Sales data by Customer Groups, 1978 to 1989, (annual) Raw Water Sales in Acre-Feet Report, May 14, 1990.
Annual Water Sales data by Customer Groups, 1990 to 1993 (monthly) Raw Water Sales in Acre-Feet Report spreadsheets for each year
Unaccounted water equals Plant No. 1 Pumpage minus Sales
* Includes water pumped, but returned to the Delta due to drinking water quality problems in Rock Slough

Methodology

Average annual demand for each Service Area was projected using data on *Residential* use (land use and population estimates); consumption rates (WUFs and per capita); *Major Industrial* and other *Non-Residential* consumption rates; intensification rates (growth that could occur above and beyond a straight-line growth projection); conservation savings; and unaccounted for water estimates. Each component of demand was analyzed to identify the appropriate data for each subarea (city or jurisdiction), and to develop reasonable assumptions about the reliability of the data, including potential ranges of variability. Demand projections were calculated by adding Residential demand, plus Major Industrial demand, plus Non-Residential demand, minus water savings from conservation (irrespective of CCWD and other retail agency programs), plus UAW (see Exhibit 3-1).

Residential demand was projected in two ways: (1) within the TWSA, acreage by land use type was calculated for all areas and multiplied by the appropriate WUF; and (2)

Exhibit 3-5
Historical Water Supplies (acre-feet)
1974 to 1993



Source: See Exhibit 3-6

outside of the TWSA, population estimates (based on Association of Bay Area Governments [ABAG] projections and reviewed with City and County planning agencies) were multiplied by a per capita consumption rate. The two methods were used for consistency with the best available data and to minimize uncertainties, as discussed later in this chapter.

Major Industrial demand was calculated for each subarea based on historical consumption records (canal sales and river diversions) and interviews with industry representatives regarding future use. Demand figures for each Major Industrial user were then assigned by industry location, and those areas were removed from the land use database. Historical use was based on industrial canal sales over the past ten years. River diversion data were also obtained from the SWRCB, and from recent reports published by individual customers. Only two Major Industrial customers (Shell Oil, Tosco Oil) identified future expansion plans.

Other *Non-Residential demand* was calculated, in most cases, by applying WUFs against land use acreage. A few exceptions are those subareas that include all types of customer demands within one per capita number.

C-099973

Exhibit 3-6
Historical Water Supplies (acre-feet)
1974 to 1993

Year	Plant No. 1 Pumpage	Local Supplies: Mallard Slough	Local Supplies: Mallard Wells	Total Local Supplies	River Diversions: City of Antioch	River Diversions: Industrial Diversions	Total River Diversions	Total Supplies
1974	78,446	17,179	0	17,179	n/a	n/a	0	95,625
1975	76,756	13,775	0	13,775	5,377	n/a	5,377	95,908
1976	125,118	0	0	0	840	n/a	840	125,958
1977	95,567	0	1,700	1,700	0	n/a	0	97,267
1978	71,757	7,511	1,120	8,631	3,332	n/a	3,332	83,720
1979	95,508	4,632	1,120	5,752	2,106	n/a	2,106	103,366
1980	88,130	9,337	1,120	10,457	3,090	n/a	3,090	101,677
1981	102,181	4,183	0	4,183	1,395	n/a	1,395	107,759
1982	71,867	14,889	0	14,889	4,229	n/a	4,229	90,985
1983	79,017	18,867	0	18,867	5,189	n/a	5,189	103,073
1984	103,929	7,535	0	7,535	4,408	2,651	7,059	118,523
1985	119,644	157	0	157	1,049	1,338	2,387	122,188
1986	111,337	5,770	0	5,770	2,756	13,788	16,544	133,651
1987	132,799	64	960	1,024	440	7,071	7,511	141,334
1988	136,864	0	960	960	0	10,638	10,638	148,462
1989	133,224	1,436	960	2,396	0	6,630	6,630	142,250
1990	135,733	0	960	960	0	7,868	7,868	144,561
1991	99,870	536	1,700	2,236	529	803	1,332	103,438
1992	104,926	491	960	1,451	1,234	6,530	7,764	114,141
1993	96,284	6,290	a.	7,250	3,132	2,534	5,666	109,200
Averages	102,948	5,633	626	6,259	2,058	5,985	4,948	114,154

Sources:
Plant No 1 Pumpage, 1974 to 1993 CCWD O&M Dept Contra Costa Canal Water Supply History
Mallard Slough TM# 4.1, Exhibit 4 1-3, CCWD's O&M Department, Water Operations Section
Mallard Wells Local Supplies less Mallard Slough production Foster Wheeler is the primary user at 960 acre feet per year
Local Supplies: CCWD's Water Conservation Plan, Appendix A, p A-11, January 1995.
River Diversions, Antioch Letter from S.E. Davis, City of Antioch Director of Public Works to W.F. Anton, CCWD, dated September 6, 1994, 1991-1993: CCWD Memo, "Historical Use Calculation for USBR" dated December 15, 1995.
River Diversions, Industrial: See Exhibit 3-8
River Diversions, Total: Sum of City of Antioch diversions and known Industrial diversions
Total Supplies: Sum of Plant One pumpage, Local Supplies and River Diversions
Note. a) No flow meter data, however, wells are pumped continuously to serve Foster Wheeler Cogeneration

Water savings as a result of *conservation* which would occur irrespective of CCWD and other retail agency programs have been estimated on an incremental basis over the study period. Savings as a result of existing local ordinances and State and Federal regulations are deducted from the demand estimates of Residential and Non-Residential use only. Because implementation of these measures is assumed to occur over time and is intended to reflect the continued conversion of plumbing fixtures in accordance with plumbing codes and market penetration, water savings have been assumed to start at 0 percent in 1990 (since WUFs and per capita rates reflect 1990 conditions) and increase to 10% (by 2% increments per decade) by the year 2040.

Unaccounted for water was added to the demand estimates where it was not included in the per capita assumptions. Distribution losses were estimated at 7% within the TWSA (based upon historical records), and from 6 to 14% for the remaining portions of the Service Area Alternatives. In addition, annual unaccounted for water in the Contra Costa Canal is estimated at 7,000 ac-ft.

The analysis used the latest and best available information, maintaining consistency with methods currently used by agencies within the study area. For example, CCWD uses WUFs, which rely on County General Plan land use designations, to project demand within its TWSA. Other jurisdictions use per capita rates, documented in their planning studies. Development of a single methodology for all areas would have required additional assumptions on converting from one set to the other (WUFs to per capita or vice/versa). Adding assumptions to the analysis would increase the uncertainty of the results. Use of the two methodologies avoided a duplication of work and allowed the use of the best available data for the different geographic areas. It also allowed the projections to be consistent with the methodology used by the local water planning jurisdictions.

Average annual demand represents demand in an average year, and is the amount of water that would be used in the absence of water reductions potentially imposed because of drought.

Demand Projections

Average annual demand for Service Areas A through F, in ac-ft/yr, was projected for each of the years 1990, 2000, 2010, 2020, 2030 and 2040, as shown in Exhibit 3-7. Average annual demand represents demand in an average year, and is the amount of water that would be used in the absence of water reductions potentially imposed be-

Exhibit 3-7
Average Annual Demand Projections,[2] 1990-2040, (ac-ft/yr)

	1990 [1]	2000	2010	2020	2030	2040
Service Area A	146,100	169,900	187,500	196,600	200,800	202,400
Service Area B	146,900	172,800	194,500	205,100	209,900	211,700
Service Area C	149,300	175,600	198,000	209,500	215,100	217,400
Service Area D	151,400	179,800	206,800	220,600	227,400	229,700
Service Area E	153,600	184,900	219,400	237,300	245,300	247,600
Service Area F	160,200	193,900	234,500	273,100	287,900	297,000

Notes:

All projections for the years 1990 through 2040 have been rounded to the nearest hundred.

1 The 1990 demand shown is not actual but an estimated demand level for 1990, based on the characteristics of each Service Area in 1990. See "Comparison of Actual Sales and Projected Water Use" toward the end of this Chapter.

2 Demands shown are average year demands, a portion of which may be met through other supplies (Antioch and Major Industrial diversions) in normal and wet years. It is assumed all demands will be met through CCWD supplies during dry years (except groundwater).

cause of drought. Drought demand is often higher than average demand as the effects of hot and dry weather usually increase the use of both interior and exterior water.

The normalized average annual demand (not affected by drought) projected to occur in 1990 for the six Service Areas ranges from a low of 146,100 ac-ft/yr for Service Area A to 160,200 ac-ft/yr for Service Area F[3]. Projected 1990 demand for Service Area A is quite close to actual use in 1990, when total demand based on all uses is taken into account.

3 The 1990 demand shown is not actual but an estimated demand level for 1990, based on the characteristics of each Service Area in 1990. See "Comparison of Actual Sales and Projected Water Use" toward the end of this Chapter.

The average annual demand for the horizon year of 2040 ranges from a low of 202,400 ac-ft/yr for Service Area A to 297,000 ac-ft/yr for Service Area F. The average annual demand for Service Area F is greater than Service Area A by 94,600 ac-ft, or 47%, in the year 2040. The projections for Service Area F include demand resulting from the assumed development of an additional 54,000 acres of land, as well as the intensified development of other lands and the resulting potential increases in population. Service Area F demand ranges from a 4% increase in 1990 to a 20% increase in the year 2040 over demands shown for Service Area E. Of the 20% overall increase shown for the year 2040, 2.4% results from the assumed densification in the TWSA, 5.4% from the assumed densification in the RWSA, and 12.2% in the remaining rural East County areas.

Comparison of this Study with previous demand projections showed little difference.

The District's last comprehensive demand analysis was conducted for the Los Vaqueros project. The Los Vaqueros planning area is similar though slightly smaller than Service Area A. A comparison of demands shows close correspondence between the two analyses. The average annual demand projections for this analysis represent demand for a given geographic area, irrespective of supply source. A significant difference between the two studies is that the Los Vaqueros Project planning started with the estimated future demand of 205,800 ac-ft (for a horizon year of 2025) and subtracted savings from assumed new conservation programs as well as supplies not delivered through the Contra Costa Canal (including assumed new reclamation projects and water supplied from other water right holders). The correct values to compare between the two studies are the 191,400 ac-ft/yr (205,800 ac-ft/yr [minus 7% conservation irrespective of District and other retail agency programs] for the *Los Vaqueros Project),* and the 198,700 ac-ft/yr interpolated from the FWSS for the year 2025. The results represent a 3.8% increase (with implementation of CPA 1, the canal demands for the two studies are very similar,[as shown on page 6-24]) for current projections generated within the FWSS compared to those determined earlier for the Los Vaqueros Project.

With implementation of CPA 1, the canal demands for the two studies are very similar (as shown on page 6-24).

The following sections further explain the data used to project demand.

Projections of Future Land Use. Land use mapping and designations were provided by the State's Teale Data Center and the Contra Costa County General Plan, for use and development within the Geographic Information System (GIS) developed for this Study. The 1991 Contra Costa County General Plan will be reevaluated by the County by 2010.[4] Recent Local Area Formation Commission (LAFCO) and CCWD maps were used to update peripheral boundaries of the CCWD service area and city boundaries to reflect the latest annexation information. Recent annexations up to June 1994 were reviewed by the District and have been included within the District's service area. Most of the boundaries follow the SOI boundaries, as approved by LAFCO. Exhibit 3-2 displays each of the six Service Areas.

4 Land use designations are made within the jurisdictions of the City and County.

Projections of Population Growth. Population projections for each Service Area were studied and developed by decade from 1990 to 2040. Population estimates for all census tracts and subareas within the Service Area boundaries were developed with the use of ABAG's *Projections '94* digital database, by census tract. Census tracts split by service area boundaries were closely analyzed and population determined with the assistance of ABAG's correspondence table, CCWD's Census Tract/Population Estimate Database, the review of general plans and specific plans for the affected cities within the study area, and input by the agencies involved during meetings held in August and September 1994. (Agencies reviewed land use and population data, not demand data.)

ABAG projections extend to the year 2010. To project demand beyond 2010, the District extended the population figures beyond ABAG data to the year 2040. This was achieved by analyzing the growth curves for prior decades for each of the subareas, and then extrapolating the curves to the year 2040 with some adjustments based on local land use plans. The years 2020 and 2030 were then interpolated between ABAG's estimate for the year 2010 and the District's estimate for the horizon year of 2040. These extended projection years were reviewed with the jurisdictions involved, and some minimal adjustments were made.

To project demand beyond 2010, the District extended the population figures beyond ABAG data to the year 2040.

Water Use Factors. The District has previously developed and used water use factors. The FWSS used WUFs to determine future water demand for most uses within the TWSA, and for those Non-Residential uses outside of the TWSA not already included within a subarea's per capita rate. To avoid duplicating previous work, the District assumed that WUFs accurately reflect recent (and unaffected by drought water reductions) consumption patterns since they were developed over the years 1988, 1989 and 1990, coinciding with the onset of the FWSS study period. The WUFs were merged with GIS data and applied to each of the land use categories for each Service Area. This
3-12 method assumes that all parcels will be developed according to the 1991 Contra Costa County General Plan, and that residential parcels will be developed at a density which falls within those designated land use ranges.

The application of WUFs to land uses only applies to demand for the year 2010, the horizon year for the County General Plan. To obtain a reasonable demand curve for the Study period, a growth curve was created using ABAG data. The growth curve, identified by charting population projections for the period 1990-2040, was then applied to the 2010 demand projections derived using the WUF method to project data for the interim and horizon years.

Per Capita and Per Household Consumption Rates. For areas outside the TWSA, consumption figures were obtained on each jurisdiction, typically from existing water master plans, and then reviewed to determine per capita or per household consumption rates. These existing data were used: (1) to avoid duplication of work by other agencies, and (2) to maintain consistency with recognized methods already used by each agency in calculating existing and future water demands. Per capita rates for these areas range between 141 gallons per capita per day (gpcd) in Antioch to 264 gpcd in Discovery Bay.[5] Each city is unique in calculating consumption rates; for example, some include all customers within a consumption rate, while others include only residential customers.

Major Industrial Demand. Major Industrial demand includes three components: canal sales, river diversions and growth. Exhibit 3-8 displays water sales and river diversions for Major Industrial customers for the period 1984-1993. Major Industrial customers, the top five raw water users in the industrial category, account for approximately one-third of the District's 1990 raw water demand. From 1984-1993, total canal sales to

5 Diablo Water District's (DWD) Master Plan (February 1991) used an average 560 gallons per day per dwelling unit (gpdpdu), and showed data for the 1984-1990 period which ranged from 538 to 616 gpdpdu. The Master Plan average of 560 gpdpdu has been used in this Study in the analysis of DWD's demands. However, a recent analysis that takes into account 1988 through 1994 found an average of 515 gpdpdu (M. Yeraka, DWD, 1995, personal communication). While the Master Plan values have been used in the FWSS, DWD currently uses the lower figure. The effect of using the lower figure on the results of the FWSS would be small and would not affect the conclusions.

Exhibit 3-8
Water Sales and River Diversions by Major Industrial Customers, acre-feet

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	10-Year Average
Water Year Type	wet	dry	wet	crit	crit	bn	crit	crit	crit	wet	
Major Industrial Customers											
Shell Oil	9,717	9,694	9,466	10,047	9,458	8,968	10,668	9,930	10,037	9,735	9,772
Tosco Oil (14" and 30")	9,565	9,756	9,983	10,874	10,318	10,528	12,491	9,023	10,366	10,762	10,367
USS-Posco (18" and 24")	7,521	7,677	7,133	7,610	7,439	7,686	5,587	6,200	5,627	6,050	6,853
Gaylord Container[c]	5,472	14,006	7,387	15,856	21,234	15,292	16,649	7,972	2,465	546	10,688
Total Industrial Canal Sales	32,275	41,133	33,969	44,387	48,449	42,474	45,395	33,125	28,495	27,093	37,680
Diablo Water District											
DuPont[d]	825	868	878	874	1,171	1,303	1,303	1,219	1,317	1,345	1,110
Total Major Industrial Canal Sales											38,790

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Industrial River Diversions										
Tosco Oil	2,620	1,310	860	0	0	a.	a.	a.	a.	a.
USS-Posco	b.	b.	12,900	b.	b.	a.	3,200	a.	5,600	a.
Gaylord Container	a.	a.	a.	7,040	10,600	6,592	4,630	783	909	2,496
DuPont	31	28	28	31	38	38	38	20	21	38

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	10-Year Average
Municipal Diverters											
City of Antioch	4,408	1,049	2,756	440	0	0	0	529	1,234	3,132	1,355
Mallard Slough (CCWD)	7,535	157	5,770	64	0	1,436	0	536	491	6,290	2,228

Notes
a) Denotes diversions may have taken place, but no records have been found.
b) Annual data not available but average from 1984 to 1988 is believed to be 12,900 ac-ft/yr
c) Gaylord is combined with figures for Louisiana Pacific. Although closed, a replacement of comparable demand is assumed
d) Industrial sales of water to DuPont via Diablo Water District.

Sources
CCWD Total Industrial Canal Sales
Tosco, 1984 to 1986 SWRCB, Division of Water Rights Personal communication (R. Duff), September 1994
1987 and 1988 CCWD, Los Vaqueros Memorandum dated Oct. 15, 1990, from Bill Blackmer (Converted and rounded from MGY)
USS-Posco, 1986 and 1990 Steel Mill Modernization Draft EIR, January 1992 (Converted and rounded from GPM data)
USS-Posco, 1992 DDSD/CCWD Industrial Water Recycling Project (Converted and rounded from MGD)
Gaylord Container diversions, 1991 CCWD memorandum 1984 to 1986 not available 1987 CCWD memo "Historical Use Calculation for USBR", dated December 15, 1995
Gaylord Container, 1988 SWRCB, Division of Water Rights Personal communication (S. Okada) September 1994, but unconfirmed by Gaylord
Gaylord Container, 1989-90 Personal communication (C. Muma) on 11/29/95, 12/7/95 and 1/18/96, shown for completeness, not needed in projection methodology
Gaylord Container, 1991-1993 E-Mail Message from Bill Zenoni to Art Jensen, November 3 1994 (Converted from MG data for fiscal year ending Oct. 30)
DuPont, Updated data from Mike Yeraka, Diablo Water District, 12/6/94 and 7/96
DuPont, 1984-1993 River Diversions, SWRCB, Division of Water Rights Personal communication (S. Okada) December, 1994
Mallard Slough, 1984-1993 CCWD's O&M Dept, Water Operations Section
City of Antioch diversions Letter from S. E. Davis, City of Antioch Director of Public Works to W. E. Anton, CCWD dated September 6, 1994 (Converted from MGY)

Major Industrial customers such as Tosco Oil, USS-Posco, Shell Oil and Gaylord Container ranged between 27,093 ac-ft and 48,449 ac-ft/yr (recently Gaylord has sharply curtailed production; however, it is assumed that an industry of comparable water needs will maintain this demand). Historical canal sales over that period for Major Industrial users averaged 37,680 ac-ft/yr.

DuPont, a Major Industrial customer within the Diablo Water District, uses approximately 1,110 ac-ft/yr (1984-93 average). This amount was added to the historical average for the other Major Industrial users for a total of 38,790 ac-ft/yr.

Some Major Industrial customers divert water from the San Joaquin River. Some of these diversions are on a regular basis, and others are on an irregular basis since they are limited by water quality, especially in critically dry years. The SWRCB Division of Water Rights, Permits and Licenses supplied river diversion information for these industries, but records are incomplete. However, from data available, it was determined that Major Industrial canal sales represent an inverse relationship to river demand, as water year types change. Therefore, an analysis of wet and critically dry years would reasonably indicate those diversions. This information was used to develop an average diversion.

For the period 1982-1993, it was found that canal sales during a critically dry year averaged 39,970 ac-ft, while sales during a wet year averaged 28,579 ac-ft, a difference of 11,391 ac-ft (DuPont was not included in the analysis due to lack of data). One-half of the difference (5,700 ac-ft) between critically dry and wet year canal sales for the period was then used to represent a figure for average river diversions, and added to the historical average canal demand. The combined figure represents the total Major Industrial demand.

Two major industries have reported plans for future expansion in recently published documents. Shell Oil and Tosco Oil plan to increase future water demand by 5,000 ac-ft/yr and 3,000 ac-ft/yr, respectively. These demands were included, beginning with the decade beginning in 2000.

Other Non-Residential Demand. Non-Residential demand, which includes minor municipal and minor industrial customers, has historically accounted for an average of 2.7% of total consumption. A combination of homeowners' associations, agricultural and temporary uses, account for 2.8%; the category has generally declined since 1978. Demand by these customers has been calculated using WUFs.

A major Non-Residential land use requiring separate analysis was the Concord Naval Weapons Station (CNWS), which was assigned a water demand number based on historical use. A demand of 380 ac-ft/yr is assumed as a total demand for lands within the CNWS boundary. Almost 5,000 acres of the station are currently designated PS (public semi-public) consisting primarily of open space.

Intensification. The extended planning horizon for the FWSS necessitated speculation about potential development beyond the year 2010, when many cities and the County will reevaluate their general plans. Intensification assumptions are applied to Service Area F only and assume increasing permitted residential densities and related increases in supporting services. Intensification would occur over time, as allowed by revisions in the County General Plan and associated local general plans. Potential scenarios for actual development between the years 2010 and 2040 include:

- densification of existing urban areas (Residential and Non-Residential) through redevelopment, or rebuilding to higher but permitted densities;
- suburbanization of rural or agricultural areas (not including the agricultural core);
- changes to the ULL after the year 2010;
- conversion of industrial areas or military bases to mixed uses, including residential uses;
- revised general plans and policies, including changes to permitted slope construction and growth management plans; and
- changes in the 65/35 non-urban/urban ratio, which now limits urban development to 35% of the land in the County.

"How is densification taken into account?"

CFG comment 7/27/94

Areas within the cities of Antioch, Brentwood and Pittsburg were originally identified for intensification within Service Area F, based on the densification concept used in the *Phase I East County Water Supply Management Study*. Through discussions with District staff and the Customer Feedback Group, it was determined that cities within the TWSA are just as likely to experience intensification or redevelopment. Most of the cities within the TWSA are already approaching levels identified for "ultimate buildout" and would probably be intensified before the cities identified in the East County study.

Based on future uncertainties, the potential for intensification could affect population estimates. Intensification was assumed to result in an overall increase in Residential, Non-Residential and Major Industrial water demand in Service Area F of 20% over Service Area E, in the year 2040. The distribution of the 20% increase is as follows: Residential, 7%; Non-Residential, 5%; and Major Industrial, 8%. Total increases in these customer groups combine to represent an increase in demand of 49,400 ac-ft/yr over Service Area E in the year 2040. Service Area F includes a large amount of agricultural land inside and outside the ULL, and it is assumed that one-half of the overall intensified growth would occur in converted agricultural lands, but no development would occur within the agricultural core.

There are approximately 11,200 acres designated as agricultural core and approximately 34,000 acres designated as agricultural land within Service Area F. The intensified population figure would represent approximately 95,390 additional people in 2040 (over that of Service Area E). Of this amount, it is assumed one-half would populate agricultural lands (not within the agricultural core). This would equate to approximately 17,344 new housing units. Assuming two dwelling units (du)/acre, such a population would require approximately 8,671 acres. If those same units were placed in a density of six du/acre only 2,890 acres would be required. (These density assumptions are representative of the single family residential low [SL], and single family residential high [SH], County land use designations.) Under both scenarios, it is only necessary to assume 9 to 28% of existing agricultural lands would be converted to achieve such growth. This would not, however, include lands necessary for non-residential support services. This discussion is not meant to advocate conversion of agricultural lands in this or any manner, but is presented as a high demand scenario for analytical purposes.

Conservation. Water savings from the existing State, Federal and local conservation ordinances are estimated to range between 0% (1990) and 10% at the end of the Study period (2040), irrespective of District and other retail agency interim or long-term programs. These water savings include measures that already exist in State, local or Federal law, and savings attributed to the normal replacement of conventional water using devices (e.g., toilets and faucets) with water saving devices. State requirements for water savings hardware in new construction, the replacement of conventional toilets with low-flow hardware in existing households, and the greater awareness and willingness on the part of customers to apply conservation measures even in non-drought years are expected to save an increasing percentage of overall water demand in the future. Conservation estimates for the years 2000, 2010, 2020, 2030 and 2040 are estimated at 2, 4, 6, 8, and 10%, respectively, assuming that market penetration and the meeting of newer plumbing codes will occur gradually over time. These estimates are assumed to occur within the Residential and Non-Residential sectors; Major Industrial customers are assumed to be already operating in a relatively efficient manner.

Unaccounted for Water (UAW). Unaccounted for water use occurs within all water systems and is calculated as the difference between the quantity of water delivered into the distribution system as measured at the pumping or treatment plant, and the total of all metered quantities billed to customers. UAW includes leakage in the mains and distribution system, conveyance losses, system and street flushing, meter inaccuracies and unauthorized connections or use. A UAW estimate of 7% was used in the TWSA; UAW estimates used in the other municipal distribution areas ranged between 6 and 14%. UAW figures were obtained from each city's individual water master plan. In the case of rural East County, UAW figures within the Los Vaqueros Scoping Report for that area were used. With a continuing extensive leak detection, repair and replacement program, UAW is expected to be relatively constant in future years. In addition, the UAW figure for the Contra Costa Canal was a constant rate of 7,000 ac-ft/yr, including canal seepage and evaporation and the error in estimating unmetered canal diversions.

Demand Envelope

An "envelope" was developed around the average annual demand to acknowledge the uncertainty of the demand projections for each Service Area. The demand envelope represents a possible range of variability above and below average annual demand. These ranges were developed by testing reasonable assumptions about data variability. Individual assumptions were tested to determine what effect a reasonable range of variation for each would have on total demand. Because many of the variables only influence a segment of demand, the effect on the total demand is smaller than the change in the variable being tested. It would be unreasonable to assume that all components would vary in the same direction. Rather, some variations in each component would likely offset others.

3-16 The range within the demand envelope is influenced by weather, water quality (total Major Industrial needs), uncertainty of population growth, and the uncertainty of conservation water savings (irrespective of CCWD and other retail agencies' programs). These variables potentially increase average annual demand in the year 2040 by as much as 15%, and decrease the average annual demand by as much as 10% (+15/-10%).

"Will the projections include confidence intervals (range of likely demands) or error estimates?"

CFG comment 7/27/94

The influence of weather is the best documented variable; a change in annual Residential demand of +5/-3% (*Weather Normalization Report*, CCWD 1990) would result in a variation of the total 2040 demand projections of +3.8/-2.3% (because of the portion of demand accountable to Residential and Non-Residential customers). Water quality is a demand issue with major industries that use river water; major industries' annual use of water has historically varied (by water year type) by +2%, which would result in a change in total 2040 demand of +0.5%. Long-term growth projections always contain an element of uncertainty. If Residential demand projected for the year 2040 were to occur in the year 2010, for example, total average annual demand could vary by +10%. Not only are growth projections uncertain, but so are assumptions on per capita rates and WUFs. The above variation in demand, however, should accommodate these two uncertainties. The uncertainty of water savings from conservation by others is likely to be understated, not overstated. Therefore, the variables of weather, water quality and growth could together represent a combined high range in total 2040 demand of +15%.

The uncertainty of growth for the year 2040 alone could dictate the low range in demand. If growth associated with reaching full development of the County General Plan's Land Use Map were to occur in the year 2040 instead of by the year 2010, *"Why is the envelope constructed such that the upper boundary is further from the baseline projection than the lower boundary?"*

CFG comment 2/8/95

average annual demand in the year 2040 would vary by -10%. The other element of uncertainty that could affect average annual demand is water savings from conservation (irrespective of CCWD programs). If conservation were to be twice as effective as projected (representing a 20% savings in Residential and Non-Residential demand as compared to a 10% savings used in the current projections), 2040 demand could be reduced by 6 to 8%. Although variances in growth, conservation and weather have potential for reducing demand, it is considered unlikely that all three would occur concurrently. Therefore, the potential change in 2040 demand resulting from more effective conservation (6-8%), combined with the influence caused by weather (-2.3%), were suggested as the most probable factors which could cause the low range in 2040 demand to decrease by as much as -10%.

Exhibits 3-9 and 3-10 represent the high and low ranges calculated from the average annual demand for each Service Area for the period 1990 to 2040. High demand for the year 2040 ranges between 232,800 ac-ft/yr for Service Area A and 341,600 ac-ft/yr for Service Area F, a difference of 108,800 ac-ft/yr.

In Exhibits 3-11 through 3-16, a band around each projection illustrates a narrower range for the immediate future, as opposed to the horizon year 2040 where a larger range would be expected to occur due to increased uncertainties in population growth. As uncertainty increases over time, the variables of uncertainty are introduced incrementally by decade. The influence of weather within the District is known to affect current demand and accounts for most of the small range represented by the demand envelope in the year 1990 (+5/- 3%). The range increases by decade to +15/-10% in the year 2040. These exhibits chart a demand envelope for the base, interim and horizon years. Average annual demand has been bound by the same high and low percentages for each Service Area, with increasing percentages occurring as the projections approach the horizon year of 2040.

The average annual demand shown in Exhibits 3-11 through 3-16 represents average demand throughout the Service Areas. Under average demand (normal year) conditions, some of the demand is supplied from Mallard Slough diversions, the City of Antioch diversions and major industries with diversion water rights.

Demands on the District's canal are highest in critically dry years primarily because the water quality in the Delta would reduce or eliminate Mallard Slough, Antioch and industrial diversions. In addition, higher annual evapotranspiration rates produce a higher demand for landscaping and other outdoor uses. The historical demands for some critically dry years are particularly low because of reduced water supply allocations in those years resulting in the need for intensive conservation efforts or mandatory rationing.

In wet years, canal demands are at their lowest. River diversions are typically high when water quality in the Delta is compatible with municipal and industrial use. The lower annual evapotranspiration rates under wet year conditions result in a lower demand for landscaping or other outdoor purposes.

Exhibit 3-9
Demand Projections, 1990-2040, (ac-ft/yr)
High Range

	1990	2000	2010	2020	2030	2040
Service Area A	153,600	181,900	204,500	218,300	226,900	232,800
Service Area B	154,400	185,000	212,100	227,700	237,200	243,500
Service Area C	156,900	188,000	215,900	232,600	243,100	250,000
Service Area D	159,100	192,500	225,500	245,000	257,000	264,200
Service Area E	161,400	198,000	239,300	263,500	277,200	284,700
Service Area F	168,400	207,600	255,700	303,300	325,400	341,600

Notes:
All projections for the years 1990 through 2040 have been rounded to the nearest hundred.

The year 1990 is represented as 105.1% of the average year demand.
The year 2000 is represented as 107.1% of the average year demand.
The year 2010 is represented as 109.1% of the average year demand.
The year 2020 is represented as 111.0% of the average year demand.
The year 2030 is represented as 113.0% of the average year demand.
The year 2040 is represented as 115.0% of the average year demand.

Exhibit 3-10
Demand Projections, 1990-2040, (ac-ft/yr)
Low Range

	1990	2000	2010	2020	2030	2040
Service Area A	140,800	161,600	176,000	182,000	183,300	182,200
Service Area B	141,600	164,400	182,500	189,800	191,600	190,500
Service Area C	143,900	167,000	185,800	193,900	196,300	195,700
Service Area D	145,900	171,000	194,100	204,200	207,600	206,700
Service Area E	148,100	175,900	205,900	219,600	223,900	222,800
Service Area F	154,400	184,400	220,100	252,800	262,800	267,300

Notes:
All projections for the years 1990 through 2040 have been rounded to the nearest hundred.

The year 1990 is represented as 96.4% of the average year demand.
The year 2000 is represented as 95.1% of the average year demand.
The year 2010 is represented as 93.8% of the average year demand.
The year 2020 is represented as 92.6% of the average year demand.
The year 2030 is represented as 91.8% of the average year demand.
The year 2040 is represented as 90.0% of the average year demand.

Exhibit 3-11
Demand Envelope, 1990-2040
Service Area A

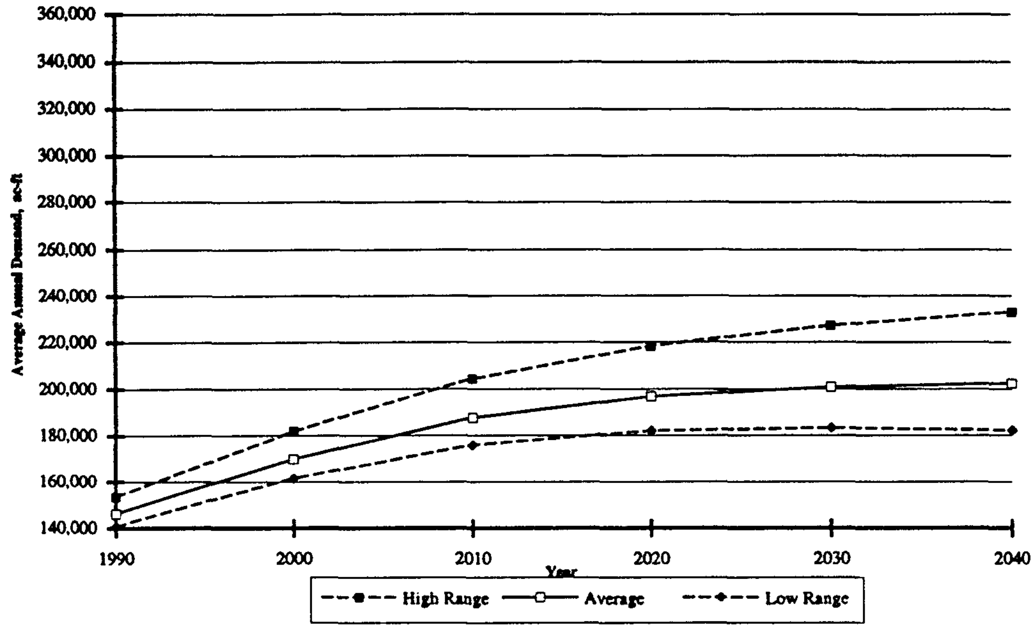


Exhibit 3-12
Demand Envelope, 1990-2040
Service Area B

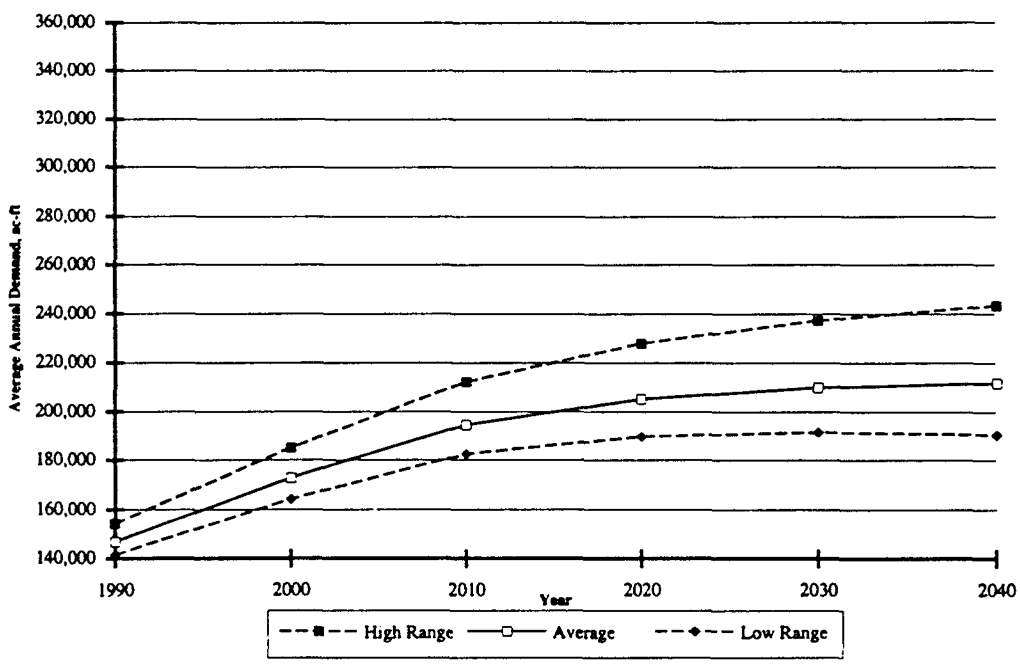


Exhibit 3-13
Demand Envelope, 1990-2040
Service Area C

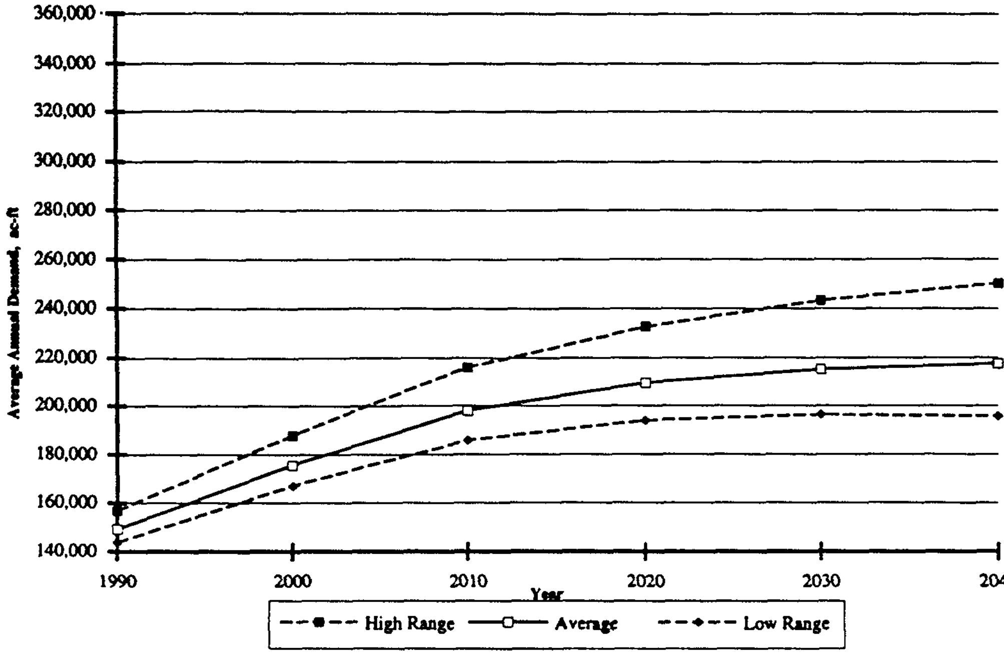


Exhibit 3-14
Demand Envelope, 1990-2040
Service Area D

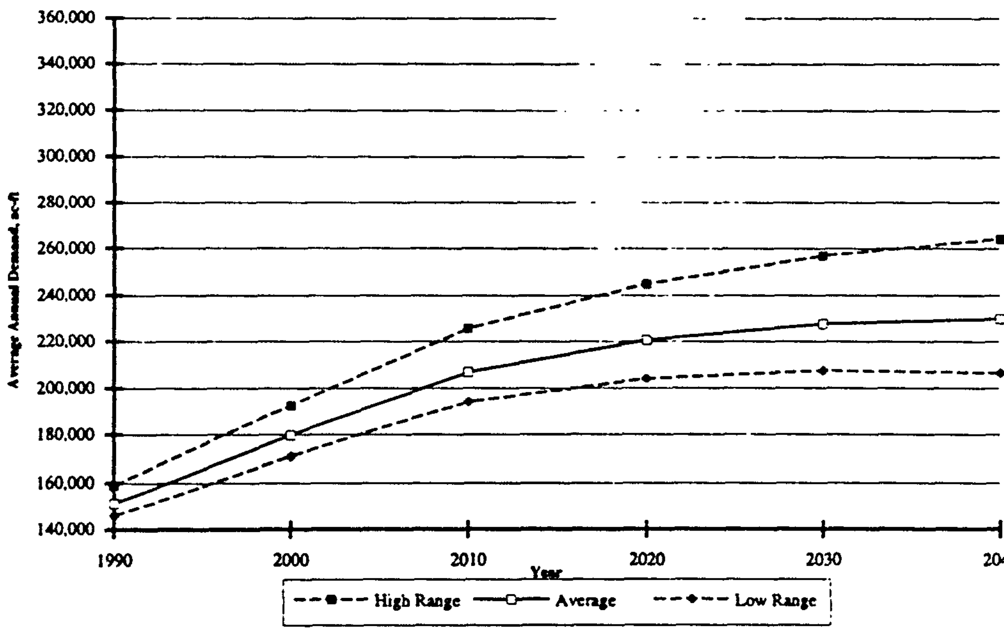


Exhibit 3-15
Demand Envelope, 1990-2040
Service Area E

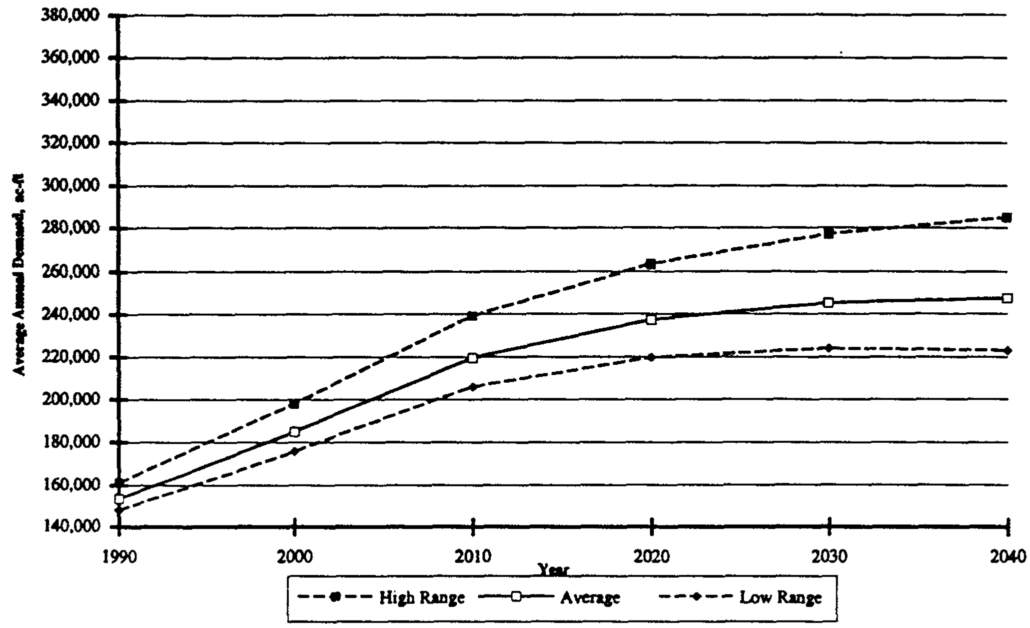
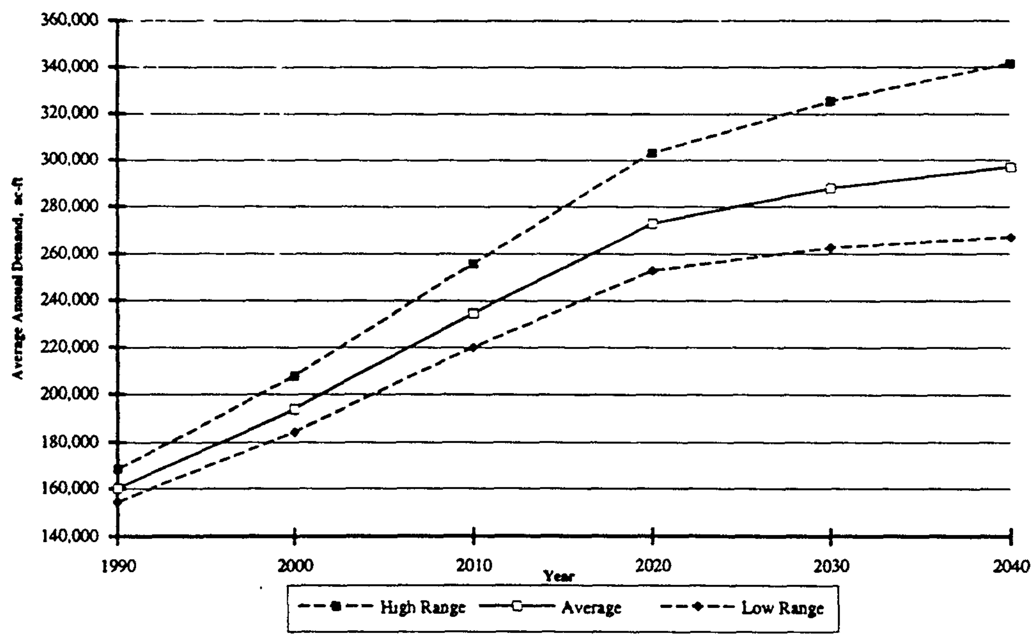


Exhibit 3-16
Demand Envelope, 1990-2040
Service Area F



SERVICE AREAS FOR FURTHER STUDY

Six Service Areas were mapped for utilization in the demand projections. For development and evaluation of the FWSS Resource Alternatives, the District selected three Service Areas for further study. During the Board Workshop on April 12, 1995, the Board agreed to focus further study on Service Areas C, E and F, represented in Exhibit 3-17. Service Area C represents planning areas of the District's existing raw and treated water customers. Service Area E would add the City of Brentwood and that city's planning area, Discovery Bay, Cowell Ranch, Byron, East County Airport, and the rural county areas between the cities of Pittsburg, Concord and Clayton. Service Area F includes the remainder of East County. These service areas were chosen due to their differences in demand. There was a 7% difference among demand for Service Areas A, B and C in 2040; Service Area C, which also represents the District's existing planning area, was therefore chosen for further study. Between Service Areas D and E, there was only a 8% difference. Service Area F, representing a 20% increase over Service Area E, examines the potential for servicing the remainder of East County lands, outside the ULL and represents the largest potential demand under a high growth scenario.

During the Board Workshop on April 12, 1995, the Board agreed to focus further study on Service Areas C, E and F, represented in Exhibit 3-17. Because the District's existing planning area does not go beyond Service Area C, the District is limited to decision-making only in that area.

The original reason for studying a range of service areas was to ensure that any decisions made did not preempt flexibility in future decision making, in the event that the District may be required to serve new growth areas. Because the District's existing planning area does not go beyond Service Area C, the District is limited to decision-making only in that area. However, examination of potential service to an expanded area such as Service Areas E and F is useful for planning purposes.

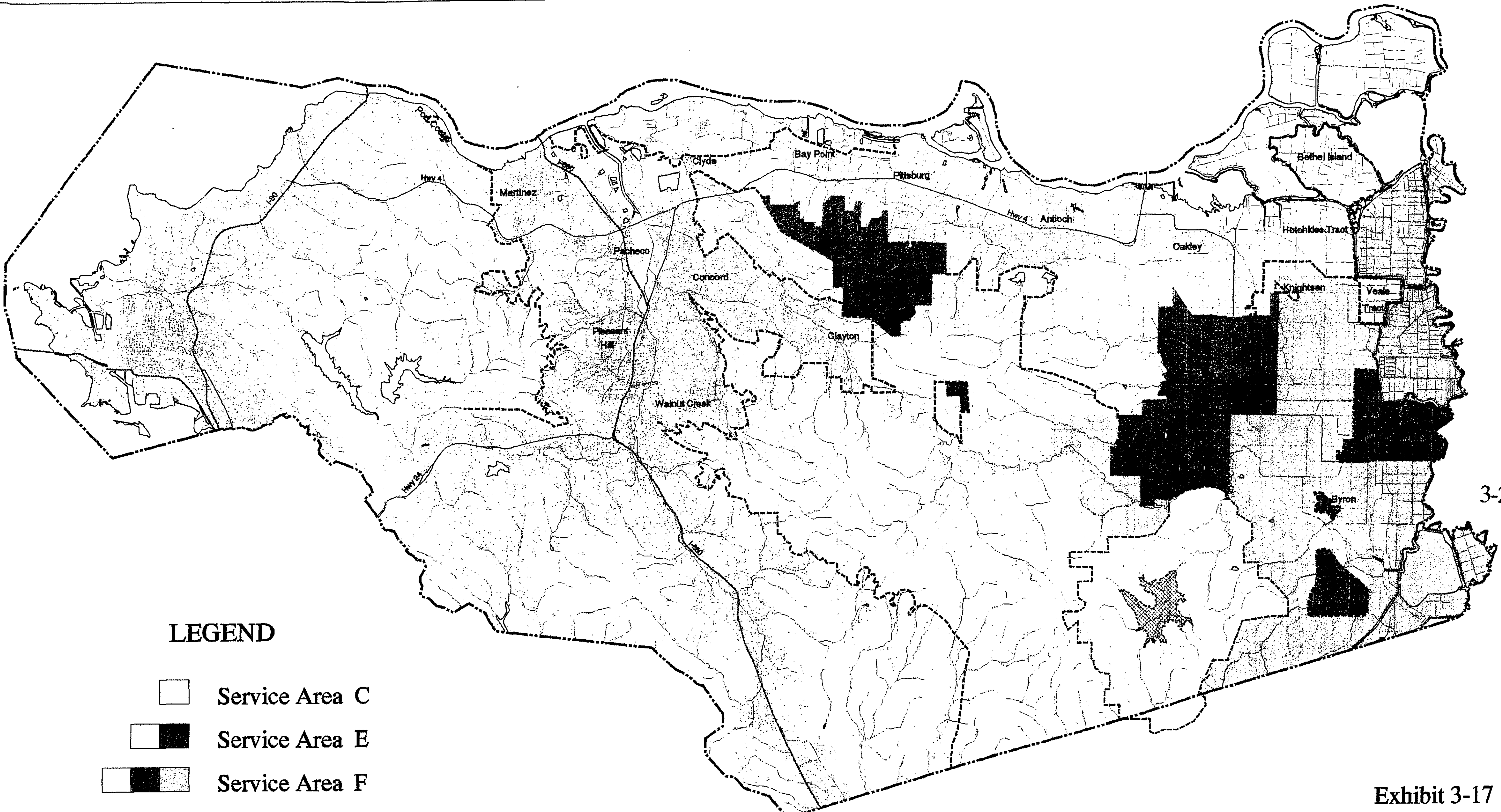
Developing resources to solve for demand in Service Area F, representing the high end of demand, has been controversial. However, solutions developed for a larger service area are valuable in that such solutions would also represent a more reliable, although costlier, water supply solution for a smaller service area. Resource Alternatives for Service Area F, with minor adjustments, could also be used to represent more reliable solutions for Service Area C. The solution for a larger service area could also present an opportunity for the District to participate in a joint project with other agencies to develop a comprehensive solution involving regional storage or developed water through surface water storage reservoirs to provide carryover storage to address fluctuations in supply.

COMPARISON OF ACTUAL SALES AND PROJECTED WATER USE

The geographic area for Service Area A is slightly larger than the service area CCWD served in 1990, and includes minor annexations through June 1994. The projected demand for FWSS includes water use in an average year and excludes the effects of drought on water use. Projected demand also includes unaccounted for water and average river diversions for Major Industrial customers, which are not reflected in District sales figures. Accounting for these differences, projected demand was less than 2% higher than actual water use in the year 1990.

Projected demand was less than 2% higher than actual water use in the year 1990.

The District began the FWSS in early 1993, acknowledging a potential future supply shortfall as witnessed during the six-year drought (1987-1992). The implications of the outcome of that period have become clearer as the FWSS has progressed and District sales over the past two years have been tallied. Starting in 1987, the District, as well as



LEGEND

Service Area C

Service Area E

Service Area F

County Line

Urban Limit Line

Los Vaqueros Watershed

N

Scale 1 : 200,000

Kilometers 1 0 1 2 3 4 5 6 7 8

Miles 1 0 1 2 3 4 5 6

1" = 3.16 miles

Exhibit 3-17

Service Area Alternatives

CCWD Future Water Supply Study

GIS Mapping by EDAW, Inc. - San Francisco

Sources: CCWD / Contra Costa County / Teale Data Center

05/23/96

the rest of the state, experienced a six-year drought. During this period, annual sales in the District hovered in the mid 130,000 ac-ft range until they fell sharply in 1991 to less than 100,000 ac-ft. The decline is generally attributed to mandatory drought management measures enacted in the summer of 1991 and the concurrent economic recession.

Although sales have increased since 1993 (wet year), they have not returned to predrought levels. In addition, a Major Industrial customer (Gaylord), which has used up to 21,000 ac-ft/yr in past years, sharply curtailed production and reduced demand to under 1,000 ac-ft in 1992, with nominal increases since then. Reduced District sales are essentially occurring due to continued public awareness through ongoing media efforts stressing long-term conservation and a state-wide recession, beginning in 1990-91, which some economists argue has achieved only marginal recovery. This phenomenon is not limited to the District, but is seen state-wide, indicating it is not driven by local activities.

Demand projections in the FWSS were based on a combination of WUFs and per capita numbers based on historical demand within the District over past years. As a result, per capita water use and water use factors used to calculate demand tend to be skewed slightly higher than post-drought water use; projected demand is therefore higher than actual demand. The development of the WUFs, for example, was based on water use in the years 1989 and 1990 (below normal and critically dry years), two of the four highest water use years within the District's history.

During the development of demand projections, a demand envelope based on average annual demand (increasing to +15/-10% in 2040) was used to acknowledge the possibility for variation in demand. Existing demand is currently below the demand envelope and is primarily due to the reduced production of the Gaylord facility and abnormally low water use from the drought and recession. The District has not experienced a complete rebound in sales as of 1996, although it is acknowledged that the last two winters have been wet. During periods of heavy rainfall, exterior demand is obviously reduced, and industrial and municipal customers with the option divert more than the average amounts of their water from the San Joaquin River, further decreasing Canal demand.

The possibility of expanding the low end of the envelope is a consideration since 1995 projections are higher than actual sales; however, demand increases are expected to occur. Shell Oil and Tosco Oil will be increasing annual water use in 1996 by approximately 6,000 ac-ft. Gaylord Container, currently in non-production mode, could experience a shift in business or be replaced by another paper producer (a water intensive process). This could potentially increase annual demand by 10,000 ac-ft or more. The economy is projected to improve in 1996, which could result in increased housing starts, and consequently increased water demand in the District, especially in East County. In addition, the last few years have been wet years and diversions from the San Joaquin River have been high, masking these demands from the District's operation of the canal. Industrial customers and the City of Antioch experienced similar increases in withdrawals. For these reasons, the projected demands presented here are reasonable and should be incorporated in the District's Implementation Plan until the FWSS is revisited in approximately five years.

CONCLUSIONS

The District examined six Service Areas to determine a logical array of potential demand levels. Average demand projections for Service Areas A through C are relatively similar, differing only 2% in 1990, with the difference increasing to 7% in 2040. Service Area E increases from 2% over Service Area D in 1990 to 8% in 2040. Service Area F increases from 4% above Service Area E in 1990 to 20% in 2040. The envelope of the demand projections, representing the uncertainty in the projections, ranges from +5/-3% in 1990 to +15/-10% in 2040.

To put these projected demand levels in perspective, it is useful to compare them to the current supply. The District's current CVP contract (1994 Amendatory Contract) has a maximum supply entitlement of 195,000 ac-ft/yr, but allows shortages as low as 75% of historical use. Regulatory restrictions on pumping, which can occur in any year, can limit CVP supply to 75% of contract entitlement (146,000 ac-ft), which would result in a shortfall even for Service Area A as early as the year 2000, and possibly sooner. The availability of supply alternatives is most critical during a dry year with pumping restrictions. This critical situation is due to the combined occurrence of water supply reductions and increased canal demands resulting from customers who can no longer divert river water due to water quality constraints. Supply alternatives to help meet the projected demands are discussed in the next chapter.

4. Meeting Water Needs

OVERVIEW

Chapter 3 examined current and projected future *demand* in the District's Service Area, including an analysis of six Service Areas to determine a logical array of demand levels. Chapter 4 addresses existing and potential *supplies* for CCWD, focusing on the Sacramento Valley, the San Joaquin Valley, the Delta, the CCWD Service Area and San Francisco Bay. The analysis begins by examining the District's existing supply system, including the distribution system and existing water rights, contracts and agreements. Building on this discussion of existing supply, the analysis examines potential future sources of water supply for CCWD, including, but not limited to, surface water sources; water conservation by others (particularly in the agricultural industry); groundwater storage/conjunctive use; water transfers, exchanges and sales; wastewater reclamation; and desalination. As any future solution for CCWD will likely include both supply and demand management components, this chapter concludes with a discussion of potential conservation programs within the District's service area. Additional details on potential supply sources are provided in Technical Appendix D, including a more comprehensive analysis of desalination and water banking opportunities. Technical Appendix C includes more information on conservation programs developed for the FWSS.

EXISTING WATER SUPPLY

CCWD obtains its water primarily from surface water sources in the Sacramento-San Joaquin Delta. Other potential water sources in the Sacramento-San Joaquin River basin include groundwater resources, water transfers and exchanges, water use reduction by other users (e.g., agriculture), recycling and desalination. Water supply and use in the basin are governed by a complex network of water rights, contracts and agreements involving CCWD, local districts and other entities. CCWD conveys, stores, treats and distributes water through the Contra Costa Canal, a system of storage reservoirs, water treatment facilities and distribution pipelines. These existing water supply facilities are further described below.

As noted in Chapter 3, some Service Area demands are met through water diversions in wetter years. Reliance on CCWD in dry years, therefore, increases as river water quality deteriorates.

Conveyance and Treatment System

CCWD is the primary supplier of water for users in north-central and northeastern Contra Costa County (Exhibit 4-1). The District's current Service Area is comprised of both a Raw Water Service Area (RWSA) and a Treated Water Service Area (TWSA). To serve water users within this Service Area, CCWD maintains raw water conveyance facilities as well as treated water production and distribution facilities. The Contra Costa Canal is the District's principal raw water conveyance facility. It delivers raw water to the RWSA which includes the cities of Antioch, Martinez and Pittsburg, as well as to the Southern California Water Company (serving Bay Point) and DWD.

The District also delivers raw water directly to some 50 industries and major businesses, 35 agricultural users and numerous landscape irrigators (CCWD, 1994b). CCWD provides treated water to its TWSA, which includes all or portions of the communities of Clayton, Clyde, Concord, Martinez, Pacheco, Pleasant Hill, Port Costa and Walnut Creek. By September 1997, CCWD expects to provide a portion of Bay Point's treated water supplies. Primary components of the conveyance and distribution systems, including the Canal, storage facilities and water treatment facilities, are described below.

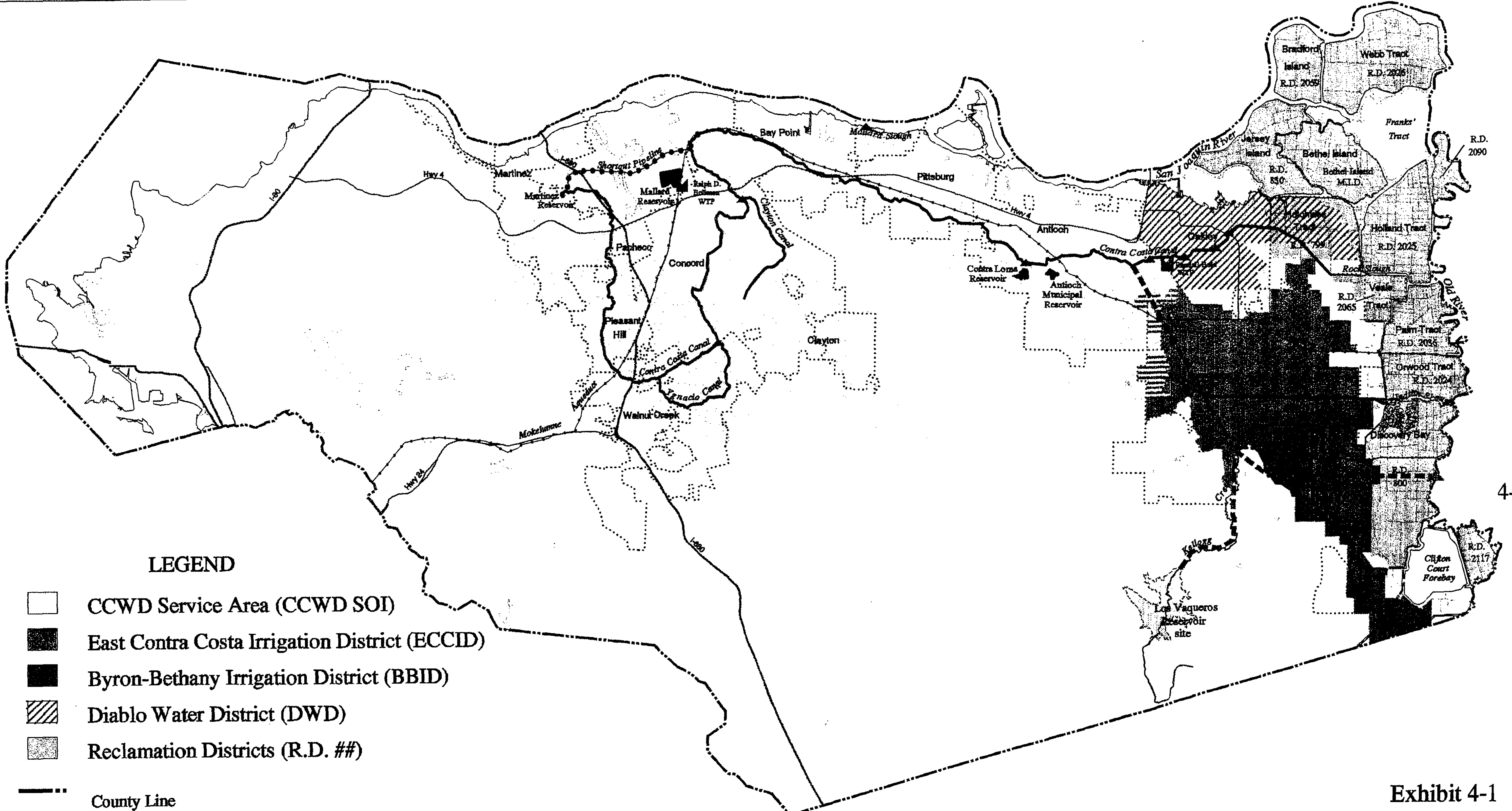
Contra Costa Canal. Raw water enters the Contra Costa Canal from the Contra Costa Intake Channel and Pumping Plant No. 1 along Rock Slough in the Delta. The Canal is 43.7 miles long beginning at Pumping Plant No. 1 and ending at Martinez Reservoir near the City of Martinez. Four pumping plants within the first 7.5 miles of the Canal lift water 124 feet to the discharge side of Pumping Plant No. 4, where water is then conveyed by gravity to the Canal's terminus. Water deliveries from the Canal to customers are made through turnouts along the length of the Canal and from lateral pipelines branching from the Canal.

Storage Facilities. There are five raw water reservoirs that store and regulate water supplies within the CCWD Service Area. Some of these are maintained and used by the District, while others are maintained and used in conjunction with, or exclusively by, municipalities.

The stand-by Contra Loma Reservoir (located in Antioch) and the Martinez Reservoir (located in Martinez) were developed to be used in conjunction with the Contra Costa Canal, and have storage capacities of 2,095 ac-ft and 268 ac-ft, respectively. The Martinez Reservoir, the terminal reservoir in the Contra Costa Canal system, is used to help regulate upstream Canal flows and feed the Martinez Treatment Plant. These facilities provide operating and emergency storage for water obtained from existing water rights in the Delta. In addition, raw water storage outside of the Contra Costa Canal system is maintained by the City of Antioch in the Antioch Municipal Reservoir, with a capacity of 73 ac-ft (Brown and Caldwell, 1991), and by some industrial users.

Mallard Reservoir was developed in conjunction with the Mallard Pipeline and Mallard Slough water rights. Mallard Reservoir has a total storage capacity of approximately 3,000 ac-ft. It is used primarily for raw water storage but also for water quality blending at the Bollman Water Treatment Plant (WTP). Raw water can be pumped to Mallard Reservoir from Mallard Slough, near Port Chicago, through the Mallard Pipeline when the water quality is acceptable in the Slough. However, the primary water source for this reservoir and the Bollman WTP is the Contra Costa Canal.

The Los Vaqueros Reservoir, when developed, will provide CCWD with an additional 100,000 ac-ft of storage. The objectives of the reservoir are to improve the reliability of the CCWD supply by providing emergency storage and to improve the quality of water delivered to the District's customers (JMM, 1988). The Los Vaqueros Project involves the construction of new intake facilities at Old River to deliver Delta water to the reservoir; however, this will not result in additional supply. The project facilities are designed to provide offstream storage of high-quality water for use during the seasonal intrusion of saltwater into the Delta, particularly at Rock Slough where CCWD currently obtains a majority of its raw water supply. The reservoir would also provide emergency storage in the event of unforeseen circumstances, such as a levee failure or chemical spill, which could make Delta water unusable for extended periods. The transfer and conveyance facility will deliver water to the Contra Costa Canal at Pumping Plant No. 4.



LEGEND

- CCWD Service Area (CCWD SOI)
- East Contra Costa Irrigation District (ECCID)
- Byron-Bethany Irrigation District (BBID)
- Diablo Water District (DWD)
- Reclamation Districts (R.D. ##)
- County Line
- City and Area boundaries
- Los Vaqueros pipelines
- pump station
- water treatment plant
- Los Vaqueros pump station

Scale 1 : 200,000

Kilometers 1 0 1 2 3 4 5 6 7 8

Miles 1 0 1 2 3 4 5 6

1" = 3.16 miles

Exhibit 4-1

Water and Irrigation Districts within the CCWD Future Water Supply Study Area

Map Prepared by EDAW - San Francisco

Sources: CCWD / Contra Costa County / Teale Data Center

06/18/96

C-099993

C—099993

Water Treatment Facilities. The Bollman WTP, adjacent to Mallard Reservoir, is the District's primary water treatment facility, serving the needs of the TWSA and having a permitted capacity of 75 mgd. The District's 1996 Capital Improvement Program (CIP) describes a series of improvements planned for the Bollman WTP, including projects to upgrade plant safety and security, ensure regulatory compliance, increase seismic reliability and improve water quality. Water quality improvements include ozone and control system upgrades required to comply with current and future health, safety and water quality regulations (CCWD, 1994d). The plant's primary raw water source is the Contra Costa Canal. Canal water can either be delivered directly to the plant, or to Mallard Reservoir, where it can be stored for later use. Approximately 722 miles of pipeline, ranging in diameter from 2 to 48 inches, distribute water throughout the TWSA.

Four other communities (the City of Antioch, the City of Pittsburg, the City of Martinez, and the community of Bay Point) treat water from the Contra Costa Canal for delivery to customers in their service areas. The combined total treatment capacity of these facilities is approximately 75 mgd. The City of Antioch has a facility composed of two major sections with design capacities of 16 mgd and 8 mgd, respectively. Additional capacity, up to 6 mgd, can be provided for limited periods (which is not included in the above total of 75 mgd). The Bay Point facility, owned and operated by Southern California Water Company, has a treatment capacity of approximately 5 mgd. The cities of Pittsburg and Martinez have treatment capacities of 32 mgd and 14 mgd, respectively.

The Randall-Bold WTP, jointly owned by DWD and CCWD, has a design capacity of 40 mgd. It is located in the East County community of Oakley and treats water from the Contra Costa Canal for delivery to DWD customers.

Water Rights, Contracts and Agreements

In addition to its existing CVP contract, CCWD also receives minor supplies from pumped diversions at Mallard Slough and through pumping at the Mallard well fields. In addition, CCWD has obtained an agreement with East Contra Costa Irrigation District (ECCID) to use up to 21,000 ac-ft/yr of ECCID water supply to service M&I demands in portions of ECCID which are now, or potentially may be, within the CCWD Service Area. An agreement with the City of Brentwood provides for the transfer of 7,000 ac-ft/yr to Brentwood for its future water needs. A review of water rights in the current CCWD Service Area identified the City of Antioch, the Gaylord Container Corporation and the Tosco Corporation as having significant surface water rights. Exhibit 4-2 lists water rights currently held within the CCWD Service Area, along with respective annual diversion entitlements.

Under ideal conditions, current agreements entitle CCWD to a total annual supply of 242,700 ac-ft, plus an additional 3,000 ac-ft produced from wells (owned by the District and others) in the District's Service Area. In reality, however, the full amount of supply (242,700 ac-ft) is not available due to deficiencies (e.g., CVP supply shortages and water quality conditions in the San Joaquin River). The water supply sources identified here are discussed in detail in the following sections.

Central Valley Project. The District's primary water supply is its' CVP entitlement. On September 18, 1951, the District entered into a contractual agreement with the United States Department of the Interior, Bureau of Reclamation (Bureau or USBR), to receive water service from the Bureau's CVP (Water Right Permit Nos. 12725 and 12726). The contract has been amended on several occasions since its original enactment. The 1994

Exhibit 4-2
Water Rights in the CCWD Service Area

Water Right Statement

Water Rights Holder and Diversion Point	State Water Resources Control Board Numbers	Place of Use	Annual Diversion Right (Ac-Ft) (a)
USBR @ Rock Slough	Permit Nos. 12725, 12726	CCWD	195,000
CCWD @ Old River (Los Vaqueros Project)	Application No. 20245	CCWD	~195,000 (b)
ECCID @ Rock Slough	Agreement with ECCID (c)	Brentwood (d), ECCID	21,000 (e)
CCWD @ Mallard Slough	License No. 3167 and Permit No. 19856	CCWD	26,700
City of Antioch @ San Joaquin River	Statement No. 009352	City of Anitoch Service Area	7,670
City of Antioch @ Antioch Municipal Reservoir	License No. 0002713	City of Antioch Service Area	Unknown
Gaylord Container Corp. @ San Joaquin River	Permit No. 019418	Gaylord Container Corporation	28,000
El DuPont De Nemours & Co. @ San Joaquin River	License No. 000674	El Dupont De Nemours & Company	1,405
Tosco Corp. Lion Oil Division @ San Joaquin River	License No. A010784	Tosco Corporation	16,650
USS Posco	Not listed with SWRCB	USS Posco	12,900

Notes:
(a) Diversion amounts represent maximum diversion capabilities and do not reflect diversion quantities available for all years.
(b) Diversion right at Old River for the Los Vaqueros Project includes capacity for CVP diversions and water quality diversions.
(c) ECCID = East Contra Costa Irrigation District.
(d) Brentwood/CCWD Agreement of October 19, 1995.
(e) Water to be made available in three blocks, phased over a 20-year period (1990-2010)
Data Source: State Water Resources Control Board records.

Amendatory Contract is effective through December 31, 2010 and provides that the Bureau will supply up to 195,000 ac-ft annually to CCWD at Rock Slough.

The CVP's ability to provide water supplies to CCWD is greatly affected by regulatory conditions in the Sacramento-San Joaquin Delta, the CVPIA and upstream water resource conditions. During regulatory restrictions, CCWD will receive the greater of 75% of the contract entitlement, or 85% of historical use. During water shortages, CCWD will receive not less than 75% of the contract entitlement or 85% of historical use (whichever is less). Under severe drought conditions, the CVP supply can drop to as little as 75% of historical use; the contract allows lower supplies during drought emergency conditions, when there is only a sufficient supply to maintain health and safety. Historical use is defined as the three-year average of CVP supplies unaffected by reductions, plus river diversions by Gaylord Container and the City of Antioch and Mallard Slough diversions by CCWD. The average is adjusted for growth in the existing Service Area, and reduced by any amount actually supplied in the shortage year by Gaylord, Antioch or Mallard Slough.

CVP Supply Shortage Analysis. The frequency of drought deficiencies incurred by CVP M&I water contractors, including CCWD, was analyzed using output from the California Department of Water Resources (DWR) DWRSIM model, which incorporates the May 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Plan); this Plan incorporated the December 15, 1994 Principles for Agreement. The Plan, adopted by the SWRCB, establishes water quality control measures to protect beneficial uses in the Bay-Delta Estuary. The Plan identifies: (1) beneficial uses to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) an implementation program to achieve water quality objectives.

DWRSIM output indicates that CVP M&I contractors (including CCWD) would suffer supply deficiencies in one out of every eight years. These deficiencies are for drought only; regulatory restrictions could result in deficiencies in any year. However, the December 15, 1994 Principles for Agreement, which led to the Plan, have reduced the likelihood of such drought restrictions. Earlier analyses with PROSIM, a model developed by the Bureau, put the drought deficiency frequency between one in seven and one in eight years, depending on the water quality standards applied. For the purposes of this Study, the expected frequency is one in seven years.[1]

1 One in seven years was used equally spaced throughout the Study period in the cost analysis as a simplifying assumption, but the implementation discussion addresses multi-year droughts.

Mallard Slough Water Rights. CCWD has additional water rights at Mallard Slough (License No. 3167 and Permit No. 19856) for a maximum diversion of Delta water of up to 26,700 ac-ft/yr. Diversions from Mallard Slough are unreliable due to frequently poor quality in the San Joaquin River in this area (CCWD, 1994b). In addition water under Permit No. 19856 is subject to availability of flows in excess of those needed for State and Federal projects. Water rights under the license are senior to the State and Federal projects, and the District has a contract with the DWR that compensates the District for water quality degradation caused by the State Water Project (SWP). CCWD generally halts diversions from Mallard Slough when the chloride content of the San Joaquin River exceeds 100 milligrams per liter (mg/l). The 1994 Amendatory Contract contains provisions that account for water taken at Mallard Slough against CVP allocations in years with shortages or restrictions.

East Contra Costa Irrigation District Agreement. In 1990, ECCID and CCWD entered into an agreement providing for the eventual transfer of up to 21,000 ac-ft to CCWD each year. The agreement transferred to CCWD an entitlement to use up to the transferred amount for M&I purposes within ECCID. On October 19, 1995, CCWD and the City of Brentwood entered into an agreement that provides for the transfer of 7,000 ac-ft of this supply to the City of Brentwood.

The transferred water is to be made available to CCWD, at the District's option, in three blocks phased over a 20-year period. The first block of 8,000 ac-ft/yr was made available upon completion of the agreement; the City of Brentwood has the option to purchase 7,000 ac-ft of this block by 1997. The second block, an additional 7,000 ac-ft/yr, will be available to CCWD on January 1, 2000. The third and final block consisting of the last 6,000 ac-ft/yr of the transfer amount will be available to CCWD on January 1, 2010 (ECCID, 1990). ECCID's water right is not subject to regulatory deficiencies and, therefore, neither is the portion of water transferred to CCWD.

Groundwater in the CCWD Service Area. Groundwater resources in the CCWD Service Area do not supply significant amounts of water to meet, or augment, raw water demands. Of the three major groundwater sources - Ygnacio, Clayton and the Pittsburg/Antioch areas - only the Clayton area produces appreciable amounts of groundwater, up to approximately 3,000 ac-ft/yr. Existing CCWD wells in the vicinity of the Bollman Water Treatment Plant (Mallard well fields) can provide approximately 1,000 ac-ft/yr, limited by the threat of contamination from adjacent industrial areas and physical factors such as air entrainment. Wells within DWD (up to 800 ac-ft/yr) and elsewhere in the District's Service Area can provide up to 2,000 ac-ft/yr.

Other Water Rights in the CCWD Service Area. The City of Antioch and four industrial users hold water rights from the San Joaquin River. The City of Antioch has two rights to water from the San Joaquin River and a smaller right to flows in the watershed upstream of Antioch Municipal Reservoir. Actual diversions from the river are limited, however, due to poor water quality conditions during dry years. Antioch therefore relies on raw water deliveries from CCWD to meet the majority of customer demand. Historical diversions over the period 1975 to 1993 were 2,038 ac-ft, with the highest diversions occurring during two wet years, 1975 and 1983, when 5,377 ac-ft and 5,189 ac-ft were diverted, respectively.

As noted in Chapter 3, a portion of Service Area demands may be met through water diversions in normal and wet years. However, those supplies are unavailable during dry years; therefore demand for CCWD supplies increases in those years.

Gaylord Container (Permit No. 019418) and the Tosco Corporation (License No. A010784) have rights to divert up to 28,000 and 16,650 ac-ft/yr, respectively. USS-Posco (License No. unavailable) has diverted up to 12,900 ac-ft in the past, but more recently diversions have been approximately 5,600 ac-ft. DuPont (License No. 000674) holds a right to divert 1,405 ac-ft/yr from the river. This water is allocated for industrial use and may not be available for M&I transfers. It may not be feasible to transfer this water from industrial use to potable municipal use, given constraints imposed in the existing permits and licenses, and due to unreliable water quality conditions. Because the shortage provisions of the District's CVP contract are based in part on historical use, which includes diversions by Gaylord Container, the City of Antioch and CCWD at Mallard Slough, these diversions are included in the District's CVP allocation in shortage periods.

East Contra Costa Water Supplies Outside the CCWD Service Area

ECCID and Byron-Bethany Irrigation District (BBID), for which boundaries are shown in Exhibit 4-1, hold the major surface water rights in East Contra Costa County. A number of other substantial surface water rights exist in this area according to SWRCB records. Groundwater use in this region is limited, however. The following sections describe these surface and groundwater resources.

East Contra Costa Irrigation District. ECCID is the largest water rights holder in East Contra Costa County. ECCID is located south of DWD and east of the CCWD Service Area, overlapping that area to a small extent. ECCID holds a pre-1914 water right from the Delta at Indian Slough for "irrigation purposes, domestic use, watering stock, and supplying the municipalities, towns, and the inhabitants thereof, with water for municipal and other purposes". DWR has acknowledged this water right with a contractual agreement to furnish ECCID up to 50,000 ac-ft/yr from the Delta.

ECCID also claims a year-round entitlement, which is suitable for M&I supplies, but has typically utilized its water rights primarily during the irrigation season (March-October). The change from agricultural to M&I use could increase diversions between October and March, the agricultural off-season when very little diversions occur. A seasonal change in the timing of such diversions could have potential impacts on the Delta; however, the phasing of the contract over time could potentially minimize any impact. ECCID has also adopted a policy to provide water for landscape irrigation and currently has agreements with several Brentwood developers to provide landscape irrigation water.

Byron-Bethany Irrigation District. BBID holds a pre-1914 water right for Delta diversions for an unquantified amount for the purposes of irrigation and domestic use. Diversions are currently being made from Clifton Court Forebay. In the absence of an agreement, the USBR and DWR have historically interpreted water available for transfer from pre-1914 water rights based on the historical diversion pattern. During the 20-year period 1970 to 1990, BBID annual diversions averaged approximately 40,000 ac-ft/yr (CCWD, 1994a). Historic diversions peaked at 56,000 ac-ft in 1976, and BBID diverted approximately 37,000 ac-ft in 1994. The diversion period usually occurs from February through October, the normal growing season in the district. BBID's water right, however, is not limited by these levels and is much higher; these numbers merely indicate levels that would likely be uncontested in a water transfer arrangement.

In November 1993, BBID and Zone 7 of the Alameda County Flood Control and Water Conservation District entered into a 5-year contract. The contract allows Zone 7 to purchase the option of transferring up to 5,000 ac-ft of surplus water annually from BBID. The agreement states delivery will be to Clifton Court Forebay and includes no guarantees with respect to water quality.

BBID supplies irrigation water for approximately 11,000 to 12,000 irrigable acres within its approximately 18,000 acre boundaries. BBID entered into a Water Services Agreement with the Mountain House Community Services District in San Joaquin County to provide approximately 9,413 ac-ft/yr for treated water service to the Mountain House community. Approximately 2,900 acres of Mountain House are within the BBID service area and an additional 1,900 acres are within the BBID Sphere of Influence. The remaining irrigable land within BBID would require about 30,000 ac-ft of water per year. BBID also supplies about 1,500-2,500 ac-ft/yr to the Unimin Corporation for process water at the Byron Sand Plant. BBID's current obligations, based on the items identified above, total roughly 46,000-47,000 ac-ft/yr (CCWD, 1994a and written correspondence from Rick Gilmore, BBID, July 1996).

According to the Environmental Impact Report (EIR) prepared for the Mountain House New Town development, the water quality of BBID's supply is suitable for drinking water. Some treatment would be necessary, however, to meet all maximum contaminant limits (MCLs) (CCWD, 1994a).

The Cowell Foundation entered into an MOU in May 1994 to provide financial resources to BBID to study the potential of expanding BBID's pre-1914 water rights. As soon as the determination was made that BBID could change the purpose and place of use of its historically acquired pre-1914 water rights, assuming that no injury would occur if diversions were kept below planned or historically diverted levels; a Water Services Agreement was executed by both BBID and Cowell on March 14, 1995. The agreement is an irrevocable offer to provide an annual raw water supply of approximately 3,900 ac-ft to Cowell, which would require the annexation of all or a portion of the Cowell property. All Cowell Ranch projected land uses are estimated to demand a water supply of approximately 4,500 to 5,000 ac-ft annually at buildout.

Groundwater in East County. Many urban areas, both inside and outside of the BBID and ECCID service areas, are served almost entirely from groundwater. The District's literature review on groundwater resources in East Contra Costa County indicates a low to moderate potential for additional development to meet long-term urban demand. As a result of the basin's formation characteristics and proximity to the ocean, water quality of the groundwater is often poor in terms of M&I requirements and customer acceptability. The yield of the groundwater basins in East Contra Costa County is low, as is the usable storage.

ECCID and the City of Brentwood have each developed a long-term yield of approximately 3,000 ac-ft/yr from their respective wells. From a limited number of field studies reviewed by CCWD, recharge in the vicinity of Brentwood appears to be between 3,000 and 6,000 ac-ft/yr (CCWD, 1993). The City of Brentwood, with support from ECCID, is currently investigating groundwater resources underlying the area of Brentwood (Davisson and Criss, 1994). Nitrate concentrations are particularly high in groundwater from this area primarily due to agricultural runoff, the major source of recharge over the past 80 years. The study estimates that approximately 40% of wells in the area have nitrate levels that exceed the EPA primary drinking water standard of 45 mg/l (Davisson and Campbell, 1994).

Discovery Bay depends exclusively on groundwater production for its domestic water supply. The quality of well water in the area meets primary drinking water standards but exceeds secondary standards for total dissolved solids (TDS) (Luhdorff & Scalmanini, 1994). Bethel Island (currently within the DWD Planning Area) and Hotchkiss Tract (within the DWD SOI) both rely on groundwater resources as well. If the DWD were to assume the entire responsibility for supplying water to Bethel Island/Hotchkiss Tract, the existing water systems would have to be abandoned and replaced with a system meeting State standards.

4-10 **Other Water Rights in East County.** Exhibit 4-3 contains a partial list of water rights holders in East Contra Costa County who divert water from the Delta. The list includes appropriative water rights and water right statements. It indicates that, based on full use of permitted diversion rates and diversion periods, water rights for about 209,280 ac-ft/yr exist in this area. Because water rights are limited to amounts that can be put to beneficial use, consumptive use is more representative of the actual water right and would more accurately reflect a volume of water that could potentially be transferred to M&I uses. Exhibit 4-4 indicates that the total annual consumptive use in this area is about 60,600 ac-ft.

POTENTIAL FUTURE WATER SUPPLY SOURCES

A full range of potential supplemental supply sources has been identified from water service agencies throughout the Central Valley and neighboring hydrologic regions. Several initial selection conditions were developed to identify a meaningful range of potential water supply opportunities to evaluate and screen as part of the FWSS. Selection conditions were designed to eliminate water supply sources that would not now, or in the future, provide CCWD with a reliable supplemental water supply.

The identification of a potential water supply source in this Study, however, does not imply a willingness to develop or provide resources to CCWD by a participating agency or project. The findings presented within this report are preliminary in nature, and the development of a water supply from any of the agencies or projects identified here would require specific negotiations to determine the actual amount of water that could be developed for transfer to CCWD.

The identification of a potential source of water supply in this Study does not imply a willingness to develop or provide resources to CCWD by a participating agency or project.

Exhibit 4-3
Water Rights in East Contra Costa County

Name	Statement No.	Application Number	License Number	Place of Use	Annual Diversion Right (Ac-Ft) (a)
WATER RIGHTS STATEMENTS					
John Bloomfield, et al.	S013812	N/A	N/A	Orwood Tract	10,830
Alvin R. Orman	S005235	N/A	N/A	Brentwood	510
Ernest C. Burroughs	S005234	N/A	N/A	Brentwood	1,310
The Burroughs Trust	S002319	N/A	N/A		4,740
Ernest C. Burroughs, et al.	S002298	N/A	N/A		3,090
Oscar N. Burroughs, et al.	S002300	N/A	N/A		5,390
Oscar N. Burroughs, et al.	S002299	N/A	N/A		5,390
Emerson Dairy, Inc.	S002320	N/A	N/A		2,070
APPROPRIATIVE RIGHTS					
Delta Farms Reclamation District #2024	N/A	A002950	001570	Orwood Tract	14,730
Delta Farms Reclamation District #2025	N/A	A002951	001571	Holland Tract	26,860
Delta Farms Reclamation District #2026	N/A	A002952	001572	Webb Tract	34,880
William M. Looney, et al.	N/A	A002593	000358	Orwood Tract	4,690
Mantell Brothers	N/A	A016229	006092	Orwood Tract	1,090
Church of Jesus Christ of Latter Day Saints	N/A	A006587	001605	Byron Tract	17,160
Church of Jesus Christ of Latter Day Saints	N/A	A008338	04953	Byron Tract	10,140
Palm Tract Company	N/A	A004942	01333	Palm Tract	22,300
Edna M. Fallman	N/A	A0002718	000359	Orwood Tract	1,450
H. John Bloomfield, et al.	N/A	A0002949	001852	Orwood Tract	8,510
Sheldon G. Moore, Nancy D. Moore, and Daren D. Moore	N/A	A0004635	001289	Orwood Tract	4,530
Alba C. Houston Orchard Company	N/A	A0015094	005173	Byron Tract	490
Jersey Island Reclamation District #830	N/A	A0003768	001310	Jersey Island	29,120
UNQUANTIFIED PRE 1914 WATER RIGHTS					
East Contra Costa Irrigation District (ECCID)	N/A	N/A	N/A	ECCID Service Area	50,000 (b)
Byron-Bethany Irrigation District (BBID)	N/A	N/A	N/A	BBID Service Area	40,000 (c)

Notes:
(a) Diversion amounts represent maximum diversion amounts and do not reflect actual consumptive use amounts that would be available for transfer.
(b) ECCID's annual entitlement is based on contractual agreement with the Department of Water Resources: the actual entitlement for this pre-1914 water right may exceed 50,000 ac-ft/year. The current diversion is approximately 30,000-35,000 ac-ft/yr.
(c) BBID's annual entitlement is based on historical diversion over a 20-year period from 1970 to 1990; actual entitlement for this pre-1914 water right may exceed 40,000 ac-ft/yr.
Data Source: State Water Resources Control Board records. "East County Water Supply Management Study: Phase I - Supply and Demand." Contra Costa Water District, 1994.

Exhibit 4-4
Estimated Consumptive Use of Crops
East Contra Costa County

	Pasture	Alfalfa	Field	Sugar Beets	Grain	Rice	Truck	Tomatoes	Orchard	Vineyard	Safflower	Corn	
Evapotranspiration of Applied Water (acre-feet per acre)	3.0	2.6	2.0	2.2	1.5	3.1	1.9	1.9	2.3	1.7	1.5	1.8	Total
Hotchkiss Tract	4,788	273	96	0	243	0	0	0	0	0	0	0	5,400
Bryon Tract	1,140	148	286	900	2,537	0	1,372	0	0	0	300	1,318	8,001
Jersey Island	5,757	0	0	0	44	0	0	0	0	0	0	923	6,724
Orwood Tract	0	520	0	0	1,596	0	1,155	0	0	0	0	1,368	4,639
Holland Tract	7,554	49	0	0	756	0	0	0	0	0	0	205	8,564
Webb Tract	0	0	3,478	0	2,979	0	0	0	0	0	0	1,386	7,843
Palm Tract	87	0	0	0	2,096	0	0	0	0	0	0	1,300	3,483
Bradford Tract	1,026	0	0	0	186	0	0	524	0	0	0	1,967	3,703
Veale Tract	315	939	172	0	671	0	0	0	0	0	0	121	2,218
Undesignated Area	2,793	174	0	961	414	0	0	578	67	65	0	565	5,617
Bethel Island	1,824	99	0	0	1,197	0	0	0	0	0	0	0	3,120
Coney Island	144	0	0	0	1,184	0	0	0	0	0	0	0	1,328
Total	25,428	2,202	4,032	1,861	13,903	0	2,527	1,102	67	65	300	9,153	60,640

Data Source: California Department of Water Resources Bulletin 113-3, April 1974; and California Department of Water Resources Model.

Water Supply Categories

A wide range of water supply sources was evaluated for possible transfer opportunities. The following water supply categories were identified as alternatives that could yield surplus supplies for transfer to CCWD:

(1) Surface water supplies.

(2) Water use reduction measures by others:

- Land fallowing,
- Crop shifts, and
- Agricultural water conservation measures by others.

(3) Additional reservoir surface storage that could provide new yield from currently unregulated flows.

(4) Groundwater export, substitution or conjunctive use.

(5) Wastewater reclamation.

(6) Desalination.

Surface Water Supplies. Surface water supplies are a major portion of potential transfer sources. Opportunities for surface supply transfers exist throughout the Central Valley, with the Sacramento River Valley representing the largest remaining source of surplus water. Most potential projects in this region would require some form of flow regulation to be developed. Some local entities have developed projects with yields in excess
4-12 of their current needs and have transferred surplus water supplies in recent years. Unregulated flows in the Sacramento River could be developed with the construction of new surface storage reservoirs that could capture a portion of those flows.

Surplus supplies are also available in other parts of the Central Valley in above-normal runoff years, but such supplies are unreliable and require banking arrangements in surface or groundwater storage facilities. Surplus supplies from above-normal runoff should not be discounted, however, if banking arrangements can be arranged. Banking opportunities are explored in detail in Technical Appendix D.

Surface water supplies could be made available from CVP contractors and other water service agencies or individuals/entities with water rights. In addition, State Water Contractors, as per the Monterey Agreement of December 1, 1994, are able to transfer water to non-State contractors (however, the Monterey Agreement is currently being challenged in court). In the event that a transferable water supply is identified from State Water Contractors, CCWD could negotiate with such agencies for a permanent or temporary transfer of water.

Water Use Reduction. Water use reduction measures by others include land fallowing, crop shifts and water conservation practices that could be instituted by agricultural water service districts. These three opportunities for water use reduction are described in greater detail below.

Land Fallowing. Land fallowing is a form of water conservation in which an irrigator is paid to save water by not planting a crop. The increment of water that would have been consumptively used could then be transferred to CCWD. Implementing a water transfer based on fallowing requires (among other things) identification of a willing seller, assurance that a seller has a secure right to the water to be transferred, and overcoming source area concerns about impacts from reduced agricultural income. In addition, water transferred from land fallowing is generally adjusted negatively to account for the increment of water that continues to be consumptively used on a fallowed field. Weed control measures may need to be implemented to reduce uncontrolled consumptive use on fallowed fields (DWR, 1994).

Crop Shifts. This form of transfer consists of paying an irrigator to substitute a low water-use crop for an existing higher water-use crop (DWR, 1994). The savings in consumptive use resulting from crop shifts would then be transferred to CCWD. Crop shifts have many of the characteristics of fallowing without the drawbacks of implementing weed control measures and of potential third-party economic impacts related to losses of agricultural productivity.

Water Facilities Conservation. It may be possible to implement water conservation measures in an agricultural district by reducing losses in the operation of distribution facilities and transferring the saved water to CCWD. Such an approach has been implemented in Southern California in the Imperial Valley, where the Metropolitan Water District of Southern California has paid for improved water conservation within the Imperial Irrigation District and transferred the saved water. A key element of this type of transfer is demonstrating that the water saved through conservation will not reduce the supply to other parties that may currently be recycling the "wasted" water.

Development of Additional Surface Reservoir Storage. To improve water quality and reliability conditions, CCWD is currently constructing the Los Vaqueros Reservoir. The reservoir, however, will not produce an increased water yield to CCWD. Construction of new surface storage, or modification of an existing reservoir, could potentially develop increased water yield from previously unregulated flows. The development of additional reservoir storage could also provide a mechanism to regulate water acquired from other sources. Some potential sites could develop more yield than required for CCWD needs. In such instances, it may be desirable for CCWD to seek partners in developing such projects under a joint powers arrangement. Storage or banking are discussed in further detail in Technical Appendix D.

Groundwater Export, Substitution and Conjunctive Use. Groundwater supply opportunities include groundwater export, groundwater substitution and groundwater conjunctive use with surface water. Groundwater export produces the only supply source developed directly from groundwater. However, recent legislation and legal decisions suggest that the possibility of groundwater export as a permanent supplemental source is likely to encounter potential legal obstacles. Groundwater substitution or exchanges would involve the transfer of surface water supplies to CCWD, which would be replaced by the transferring entity with local groundwater pumping to irrigate crops. Implementing a water transfer based on groundwater substitution would require identifying willing sellers who have access to groundwater and overcoming source area concerns regarding impacts from groundwater pumping. Groundwater conjunctive use does not produce a water supply; instead, it provides a regulatory mechanism for water supplies acquired from other sources.

Wastewater Reclamation. Recycled water is wastewater that is reused rather than discharged by a wastewater treatment plant into receiving waters or to land disposal (wetlands or evaporation ponds, for example). In general, the range of allowable recycled water uses increases with increasing treatment level. Therefore, recycled water projects are typically developed in conjunction with a wastewater utility. Recycled water can be substituted for raw water supplies or for non-potable uses where appropriate, thus freeing up those supplies for other more appropriate uses.

Desalination. Desalination could be developed to provide a firm supply source, or operated intermittently as a supplemental or emergency source when the primary sources experience shortages because of drought conditions or regulatory restrictions. The desalination component provides a method for CCWD to fully use existing water rights at Mallard Slough and allows the District to divert water during periods of high salinity, subject to any restrictions in the permits.

Transfers and Water Rights

The transfer of water to CCWD would involve water supply sources not under CCWD control or ownership. Transfers would have to be negotiated with one or more entities holding water rights and would depend on the entities' willingness to transfer all or a portion of their surplus rights to CCWD. Water transfers would be subject to the water rights conditions associated with the transferred supply source. Some rights are defined by the Water Code and others are contractual or based on historical practices maintained through the present time. All rights are subject to the Constitutional requirement of reasonable beneficial use. Transferable water must be "real water," as contrasted with "paper water" to which there may be rights but no beneficial use has been developed. In other words, water rights are generally limited to the amount of water that has historically been put to reasonable beneficial use. Within the study area, water rights of various entities include pre-1914 appropriations, post-1914 appropriations, riparian rights and prescriptive water rights. These water rights govern use by
4-14 CVP and SWP contractors and many other entities.

CVP Contractors. Under the CVPIA, there are provisions for public entities with CVP water service contracts and for individual water users to transfer their share of CVP water. The Bureau has also issued draft guidelines for transferring base supply water CVP entitlements. Such transfers must be approved by the contracting local entity as well as the Secretary of the Interior. A CVP water transferor can be a contracting public entity or individual water user served by such entity under a water service or repayment contract, water rights settlement contract (Sacramento River) or exchange contract (San Joaquin River). The ten principal criteria for transfers of CVP contract water are identified below.

(1) Willing buyer and willing sellers.

(2) Proposals must be submitted in writing to the Bureau of Reclamation.

(3) The contracting entity has 45 days within which to review an individual transfer and to advise the Bureau regarding impacts on water supply, operations and financial conditions of the entity.

(4) Transfer proposals involving 20% or more of project water subject to long-term contracts within a contracting agency shall be evaluated by the contracting agency and shall be subject to review in a public participation process.

(5) Transfers outside the CVP service area are subject to right of first refusal on the same terms and conditions by entities within the service area within 90 days of first public notification of the proposed transfer.

(6) Transfer quantities are limited to consumptive use or water irretrievably lost to beneficial use.

(7) The quantity of water available for transfer is limited to annual water availability (i.e., subject to contract shortage provisions).

(8) Transfers must be consistent with State and Federal environmental laws.

(9) SWRCB approval is required for transfer outside of CVP place of use.

(10) Water transferred to an entity not previously a CVP customer will be assessed a charge of approximately $25 per ac-ft (October 1992 price levels), and there would potentially be a charge if a CVP contracting entity exercises its right of first refusal.

The Bureau is authorized to transfer existing water contracts to another public entity. CCWD could buy land and/or water from an existing CVP contract entity and transfer the entire contract supply. This may be a feasible procedure, particularly if a district has drainage problems and faces a potentially limited life.

Individual Contractors. Individuals and private entities may be supplied with water by a public entity with water rights or contract entitlements. Individuals may also have their own rights. In the former case, a transfer of water from an individual water user could be made only with the concurrence of the public entity. An exception to this condition is a user within a water service agency receiving CVP water which, under the CVPIA, can transfer water subject to Bureau guidelines. In such cases, the water rights are vested in the Bureau, and the rights themselves would not be transferred--only the water allocated to the transferor.

The Bureau has contracts with individual users who diverted water from the Sacramento River before CVP operations began and who have claimed rights to water not supplied by the CVP. These Sacramento River water rights settlement contracts provide base supply water, which is the amount a user is entitled to divert during April through October without payment to the United States. The base supply can be composed of appropriated water or entitlement quantities not supported with water rights documentation, but recognized by the Bureau, or both types. Most contractors also receive CVP water for which payments are made.

The current (October 1994) Bureau guidelines for transfer of base supply water include the following principal criteria:

(1) Transfers must be made pursuant to California law (i.e., SWRCB, California Environmental Quality Act [CEQA], etc.).

(2) The quantity in normal years is limited to the average of the three highest years of use (1980-1990) and subject to available supply in critical water years. (The 1980-90 period has been challenged by water user representatives and is under reconsideration by the Bureau.)

(3) Transferable quantities are limited to consumptive use and irretrievable losses.

(4) All transferors must have Bureau-approved water conservation plans.

(5) Groundwater may not be substituted for base supply unless groundwater use is:

(a) consistent with an approved groundwater management plan; or

(b) approved by the water supplier, in the absence of a groundwater management plan and does not create or contribute to long-term overdraft.

SWP Contractors. In an agreement entered into on December 1, 1994 (the Monterey Agreement), the SWP contractors have agreed to allow for the transfer of SWP water to non-SWP contractors. There are a total of 30 SWP contractors. Since the Monterey Agreement was signed, several SWP contractors have indicated a willingness to transfer water (State Water Contractors, 1994). However, current litigation against the Monterey Agreement must be resolved before transfers can take place.

Watershed Protection and Delta Protection Acts. State statutes provide that the counties and watersheds of origin, and in particular the Delta, are entitled to water rights or water supplies adequate to meet their beneficial needs as a priority against exports from the area of origin. This specifically applies to exports from the Delta by the SWP and the CVP. The eastern portion of CCWD and other lands in East Contra Costa County are within the statutorily defined Sacramento-San Joaquin Delta (Water Code Section 12200) and have protection under the Delta Protection Act. Whether or not water rights of lands within the area of origin could be utilized to transfer water to other portions of CCWD outside of the statutory Delta is not certain, although the watershed statutes can also apply to areas immediately adjacent to and conveniently supplied from the protected area. Additionally, if the rights are riparian, the water cannot be transferred.

State law provides that water users in an "area of origin" or "watershed of origin" are entitled to the protections of the area of origin statutes.

While the extent of protection provided by the Delta Protection Act has not been adjudicated, the Act may provide special protections to the District in meeting its water supply needs. The Watershed Protection Act, enacted in 1933, gives priority to watersheds of origin and immediately adjacent areas that can be conveniently supplied (Water Code Sec. 11460). Because of the Delta Protection Act's integration with the Watershed Protection Act, which addresses water sought to be used within the watershed of origin or within areas immediately adjacent thereto which can conveniently be supplied with water derived therefrom, the District can assert that the protective statutes provide assistance for the District's entire service area.

Further study is required to assess the possibility of transferring water to CCWD from other lands within the Delta. Preliminary review by the District's legal counsel concluded that such a transfer might overcome some assertions of injury by other lawful users of water (particularly other Delta diverters) because the entire transaction could be within the Delta or adjacent areas. Such a transfer would be based on the transferor's ability to forego all or a portion of the water being consumptively used within the Delta, although some transferors outside the statutory Delta might also qualify.

Another alternative needing further consideration would be the acquisition of additional water for shortages or growth via a contract with the CVP or the SWP, under the provisions of the Delta Protection Act. The SWP contracts exempt watershed of origin contractors from water shortages. However, it is not clear whether a contract with the SWP would be advantageous to the District. Under DWR policy, a contract to simply firm-up water supplies would not be available; however, it may still be economical (compared to a water purchase in times of shortage) to obtain a contract with the SWP as a substitute for, or to supplement, CVP supplies.

Preliminary Selection Conditions

To identify a meaningful range of potential water supply opportunities, the District has identified several initial selection conditions:

(1) A potential water supply source could be transferred either directly, or by exchange, to CCWD intake facilities in the Sacramento-San Joaquin Delta. This condition effectively limits the majority of potential water supply opportunities to the Central Valley, including the Sacramento River, Central Sierra, Sacramento-San Joaquin Delta, San Joaquin River and Tulare Lake hydrologic regions.

(2) Potential water supply sources would be identified from agricultural supplies or from M&I supplies where entitlements are not completely utilized. There are few existing M&I water supplies that are not completely utilized. Similarly, the District is not considering groundwater supplies underlying urban areas because they are generally fully allocated. Therefore, potentially developable groundwater supplies are limited to agricultural sources.

(3) Potential water supply sources developed from Federal CVP contractors must have a minimum entitlement of 40,000 ac-ft. A minimum entitlement of 40,000 ac-ft is based on obtaining a dry year supply of at least 10,000 ac-ft. A CVP contractor will likely experience a 50% reduction in CVP deliveries during dry years, leaving 20,000 ac-ft available to the contractor. A transfer agreement with a CVP contractor would likely be limited to about 50% of the available supply in dry years to avoid economic impacts from transfers, leaving 10,000 ac-ft available for transfer to CCWD. This condition does not apply to CVP contractors who also hold other State water rights.

(4) Potential water supply sources must be considered reliable, based on a water service agency's ability to transfer supplies to another agency. Individual supply sources have been deemed unreliable where it is known that the water service agency has insufficient supplies to meet present or future demands, or who are actively searching for supplemental supplies themselves. The geographic regions identified as unreliable are listed below.

- **Tehama-Colusa Canal.** Federal CVP contract water supplies from the Tehama-Colusa Canal are generally inadequate to meet the existing demand in areas served by the canal.
- **South of Delta Exporters.** Due to increasing regulations, there is growing uncertainty of future Delta exports for agricultural supplies south of the Delta. This uncertainty reduces reliability of water supplies to an unacceptable level for CCWD interests. This condition effectively eliminates agricultural water supplies from water service agencies receiving water from the Delta-Mendota Canal, California Aqueduct and the San Luis Canal. Several exceptions to this condition exist where an agency receiving water from the Delta-Mendota Canal also has surface water rights from the San Joaquin River and water service agencies who have CVP exchange contracts. The water supplied to the CVP exchangers has historically been more secure than other CVP supplies served through the Delta-Mendota Canal. Other exceptions exist where a water service agency has indicated a strong willingness to enter into transfer agreements for a portion of their entitlements.
- **Tulare Basin.** With a few exceptions, water service agencies in the Tulare basin are not considered potential sources of reliable supplemental water for CCWD. The Tulare basin is severely overdrafted and represents one of California's most significant unresolved water resource problems (DWR, 1994).

Regional Availability and Transfer Conditions

Potential water supply sources for CCWD are summarized by major hydrologic region and by county in Exhibit 4-5. Exhibit 4-6 shows the general location of each of the potential water supply sources and the major water resource features associated with these supplies.

CCWD could implement transfers from a variety of surface water supply sources, as discussed earlier. CCWD could also obtain supplemental water through participation in the DWR Drought Water Bank (established from year to year), which is a continuation of the Governor's Drought Water Bank established in 1991 and reopened by DWR in 1993 (DWR, 1993b). The DWR acts as a broker in taking requests for water from agency purchasers and arranging to buy water from willing sellers. Such sellers have provided water by fallowing, groundwater pumping, water conservation and storage releases from areas throughout the Central Valley.

Regional Availability of Surface Water Supply Opportunities. While additional water supplies may be available from nearly every part of the Central Valley, it is unlikely that all of the supplemental water needs of CCWD can be met from a single transfer source. Because operational and environmental issues are associated with each new transfer pathway, it may be easier to secure water from two or more sources in a single region or river basin than to develop sources from different regions. The following discussion, organized by hydrologic region, provides a general overview of the supply availability within each of the identified regions.

Exhibit 4-7 describes each of the water supply sources identified as potential transfer partners with CCWD. Included in the exhibit are the amount and type of entitlement, the source of the supply and the availability of the supply. A majority of the potential supply sources are from agricultural water supplies and therefore available during the agricultural season.

Sacramento River Valley. The Sacramento Valley is the largest remaining source of surplus water in California. Two major proposed reservoirs, Auburn and Sites, could yield substantial amounts of surface water, if developed. There is generally a reluctance to use groundwater directly or indirectly for water transfers, although some groundwater pumping was done in 1991 and 1992 for the Governor's Drought Water Bank and again in 1994 by the Cordua and Ramirez Irrigation Districts in Yuba County. In these situations, surface water was actually transferred and groundwater used for local needs.

Central Sierra. This hydrologic region includes the Cosumnes, Mokelumne and Calaveras Rivers. The Mokelumne and Calaveras Rivers have large storage capacities relative to annual runoff, and their service areas are short of water. Storage and runoff on the Cosumnes River are relatively small. None of the water service agencies in this region meets the four preliminary conditions stated earlier for potential water supply opportunities. However, depending on how the East Bay Municipal Utility District (EBMUD) chooses to solve its water supply problems, a combination of Mokelumne and American River resources could provide some transfer opportunities for CCWD.

San Joaquin River Valley. Potential transfer supplies for CCWD could involve districts on the east side of the San Joaquin Valley from the Stanislaus River basin to the Merced River basin. The districts in this region could operate with both surface and groundwater and transfer any surplus surface water. DWR expressed strong interest in the proposed Los Banos Grande Reservoir. It would be located immediately south of

Exhibit 4-5
Summary of Potential Water Supply Sources for Contra Costa Water District

Potential Source	Water Source	Potential Water Supply (Acre-Feet)	Type of Water Supply: Surface Water	Ground-Water	Reclaimed Water	Desalinated Water
SACRAMENTO RIVER BASIN						
Shasta County						
Anderson-Cottonwood I.D.	Sacramento River	175,000	X			
Tehama County						
Corning W.D.	Thomes Creek - Corning Canal	25,300	X	X		
Butte County						
M & T Inc.	Sacramento River	17,956	X	X		
Butte W.D.	Thermalito Afterbay - Feather Riv.	133,200	X	X		
Oroville-Wyandotte I.D.	S. Fork Feather River	30,000	X			
Richvale I.D.	Feather River - Cherokee Creek	150,000	X	X		
Glenn County						
Orland Water Users Assoc.	Stony Creek - Orland Project	96,000	X	X		
Glenn-Colusa I.D.	Sacramento River	825,000	X	X		
Princeton-Cordora-Glenn I.D.	Sacramento River	67,810	X	X		
Provident I.D.	Sacramento River	54,730	X	X		
Colusa County						
Maxwell I.D.	Sacramento River	17,980	X			
Reclamation District No. 108	Sacramento River	232,000	X	X		
Reclamation District No. 1004	Sacramento River	71,400	X	X		
Colusa Basin Drain M.W.C.	Colusa Basin Drain	57,637	X			
Proposed Sites Reservoir	Sacramento River	Unknown	X			
Sutter County						
Sutter Extension W.D.	Feather River	176,000	X			
Sutter M.W.C.	Sacramento River	267,900	X	X		
Pleasant-Grove-Verona	Sacramento River	26,290	X			
Meridian Farm W.C.	Sacramento River	35,000	X			
Yuba County						
Yuba County W.A.	Yuba River	332,700	X	X		
Hallwood I.D.	Yuba River	78,000	X	X		
Yolo County						
Woodland Farms/Conaway Ranch	Sacramento River	51,162	X	X		
Reclamation District No. 999	Sacramento River	75,000	X	X		
Delta Lowlands	Delta channels	83,000	X			
Sacramento County						
Natomas Central M.W.C.	Sacramento River	120,200	X	X		
City of Sacramento	American River / Sacramento River	326,000	X			
SMUD	American River	60,000	X			
Delta Lowlands	Delta channels	107,000	X			
Placer County						
Placer County W.A.	American River	237,000	X			
Proposed Auburn Dam Reservoir	American River	200,000	X			
Solano County						
Reclamation District No. 2068	Sacramento River	45,000	X			
Delta Lowlands	Delta channels	114,000	X			
DELTA-SAN FRANCISCO BAY						
Contra Costa County						
Contra Costa W.D.	Delta channels	195,000	X	X		
East Contra Costa I.D.	Delta channels	50,000	X	X		
Byron-Bethany I.D.	Delta channels	40,000	X	X		
Delta Lowlands	Delta channels	38,000	X			
Proposed Kellogg Reservoir	Delta channels	Unknown	X			
Mallard Slough	Mallard Slough	26,700				X
Sacramento River	Sacramento River	26,700				X
Central Contra Costa Sanitary District	Reclaimed wastewater	50,000			X	
Delta Diablo Sanitary District	Reclaimed wastewater	19,000			X	
Ironhouse Sanitary District	Reclaimed wastewater	2,500			X	
Brentwood Sanitary District	Reclaimed wastewater	2,200			X	

The identification of a potential water supply source for the purposes of this study does not imply a willingness to develop or provide resources to CCWD by a particular agency or project.

Exhibit 4-5 (Continued)
Summary of Potential Water Supply Sources for Contra Costa Water District

Potential Source	Water Source	Potential Water Supply (Acre-Feet)	Type of Water Supply: Surface Water	Ground-Water	Reclaimed Water	Desalinated Water
DELTA-SAN FRANCISCO BAY (continued)						
Contra Costa County (continued)						
Contra Costa Sanitary District 19	Reclaimed wastewater	1,300			X	
Byron Sanitary District	Reclaimed wastewater	100			X	
Alameda County						
East Bay MUD	American River	150,000	X			
Bay Area Discharges	Reclaimed wastewater	400,000			X	
SAN JOAQUIN RIVER BASIN						
San Joaquin County						
Banta Carbona I.D.	Delta Mendota Canal	173,000	X			
South San Joaquin I.D.	Stanislaus River	300,000	X			
Woodbridge I.D.	Mokelumne River	116,700	X			
City of Tracy	Reclaimed wastewater	30,000			X	
Delta Lowlands	Delta channels	303,000	X			
Delta Storage Reservoirs	Delta channels	Unknown	X			
Stanislaus County						
Oakdale I.D.	Stanislaus River	300,000	X	X		
Modesto I.D.	Tuolumne River	154,400	X	X		
Turlock I.D.	Tuolumne River	400,000	X	X		
City of Modesto	Reclaimed wastewater	27,000			X	
Merced County						
CVP Exchange Contractors	Delta Mendota Canal	85,000	X			
Merced I.D.	Merced River	570,000	X			
Proposed Los Banos Reservoir	Delta	Unknown	X			
Madera County						
Chowchilla W.D.	Buchanan Dam - Madera Canal	239,000	X	X		
Madera I D	Madera Canal	271,000	X	X		
Kern County						
Berrenda Mesa W D	California Aqueduct	155,100	X			

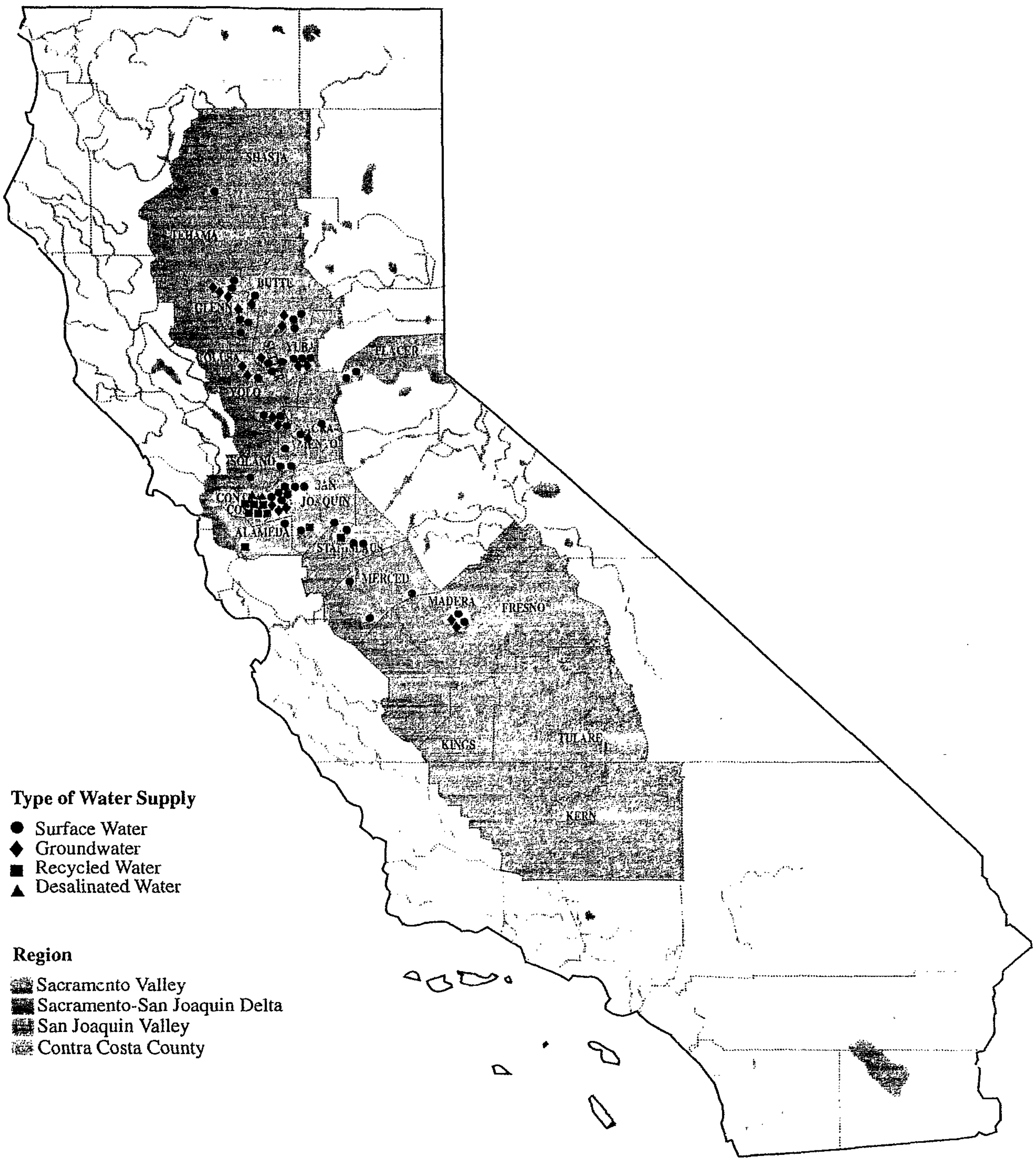
The identification of a potential water supply source for the purposes of this study does not imply a willingness to develop or provide resources to CCWD by a particular agency or project

the existing San Luis Reservoir in western Merced County. Until issues in the Delta are resolved, however, SWP contractors may not support the project. If the project becomes feasible, local partners could potentially participate with the SWP contractors in the project. CCWD could thereby obtain regulatory storage for water purchased from other sources.

Sacramento-San Joaquin Delta. Potential water supply opportunities in the Sacramento-San Joaquin Delta include crop fallowing, crop shifts and Delta island storage. Exhibit 4-8 indicates that by the year 2020, about 4.1 million acres of irrigated lands in the Delta will be producing high water-use crops (DWR, 1994). CCWD could obtain 1 to 2 ac-ft of water per acre if a high water-use crop is shifted to a low water-use crop. Crop shifts could be implemented throughout the Central Valley, although willingness to do so may be limited in areas with groundwater overdraft due to reduced water applications and recharge. Two potential surface water reservoir storage projects also exist in the Delta: the Delta Wetlands Project and Kellogg Reservoir. The Delta Wetlands Project entails conversion of existing islands in the Delta from agriculture to storage reservoirs. The Kellogg Reservoir, an offstream storage site, could develop unregulated flows in the Delta as a water supply for CCWD.

CCWD may also be able to arrange for a transfer to the CCWD Service Area of some of the ECCID water for which it has contracted and can currently be served only within

Exhibit 4-6
Potential Water Sources for Contra Costa Water District



C-100012

Exhibit 4-7
Potential Water Supply Sources For Contra Costa Water District

			Surface Water Supplies				Groundwater
Potential Source	Irrigated Acreage (Acres)	Annual Water Use (Acre-Feet)	Water Rights Entitlement (Acre-Feet)	Rights/Entitlement	Source	Supply Availability	Potential Groundwater Sources
SACRAMENTO RIVER BASIN							
Shasta County							
Anderson-Cottonwood I.D.	32,000 1	165,000 a, 1	10,000 2	CVP-Ag	Sacramento River	1	
			165,000 2	State Water Rights	Sacramento River	4	
Tehama County							
Corning W.D.	11,000 1	20,300 a, 1	25,300	CVP-Ag	Corning Canal - Thomes Creek		Substitution
Butte County							
M & T Inc.		17,956 b, 2	976 2	CVP-Ag	Sacramento River	1	Substitution
			16,980 2	State Water Rights	Sacramento River	4	
Butte W.D.	26,600 1	133,200 a, 1	133,200 a	State Water Rights - Feather River	Thermalito Afterbay	2	Substitution
Oroville-Wyandotte I.D.	31,000 1	30,000 a, 1	30,000 a	State Water Rights	So. Fork Feather River	2	
					Slate Creek	2	
Richvale I.D.	25,500 1	130,000 a, 1	150,000 1	State Water Rights - Feather River	Cherokee Creek	2	Substitution
Glenn County							
Orland Water Users Assoc.	20,000 7	76,000 7	76,000 7	Orland Project	Stony Creek	4	Export
Glenn-Colusa I.D.	175,000 1	825,000 b, 2	105,000 2	CVP-Ag	Sacramento River	1	Substitution
			720,000 2	State Water Rights	Sacramento Riv. - Stony Crk.	4	
Princeton-Cordora-Glenn I.D.	13,500 1	76,810 b, 2	15,000 2	CVP-Ag	Sacramento River	1	Substitution
			52,810 2	State Water Rights	Sacramento River	3	
Provident I.D.	16,500 1	48,747 c, 2	5,000 2	CVP-Ag	Sacramento River	1	Substitution
			49,730 2	State Water Rights	Sacramento River	3	
Colusa County							
Reclamation District No. 108	52,000 1	212,678 c, 2	33,000 2	CVP-Ag	Sacramento River	1	Substitution
			199,000 2	State Water Rights	Sacramento River	3	
Reclamation District No. 1004		71,400 b, 2	15,000 2	CVP-Ag	Sacramento River	1	Substitution
			56,400 2	State Water Rights	Sacramento River	3	
Colusa Basin Drain M.W.C.		57,637 b, 2	57,637 2	CVP-Ag	Colusa Basin Drain	2	
Proposed Sites Reservoir			Unquantified j	State Water Rights	Sacramento River	5	
Sutter County							
Sutter Extension W.D.	24,000 1	176,000 a, 1	176,000 a, 1	State Water Rights	Feather River	2	
Sutter M.W.C.		245,039 c, 2	95,000 2	CVP-Ag	Sacramento River	1	Substitution
			172,900 2	State Water Rights	Sacramento River	3	
Pleasant Grove-Verona		19,110 c, 2	2,500 2	CVP-Ag	Sacramento River	1	
			23,790 2	State Water Rights	Sacramento R (Pleasant Ck)	2	
Meridian Farm W.C.		29,212 c, 2	12,000 2	CVP-Ag	Sacramento River	1	
			23,000 2	State Water Rights	Sacramento River	3	
Yuba County							
Yuba County W.A.		332,700 5	332,700 5	State Water Rights	Yuba River	2	Substitution
Hallwood I.D.		78,000 5	78,000 5	State Water Rights	Yuba River	2	Substitution
Yolo County							
Woodland Farms/Conaway Ranch		50,862 b, 2	972 2	CVP-Ag	Sacramento River	1	Substitution
			50,190 2	State Water Rights	Sacramento River	3	
Reclamation District No. 999	25,500 1	75,000 a, 1	75,000 a, 1	State Water Rights	Sacramento River	3	Substitution
Delta Lowlands	41,572 h, 6		83,000 i	Riparian	Delta Channels	2	
Sacramento County							
Natomas Central M.W.C.		120,200 b, 2	22,000 2	CVP-Ag	Sacramento River	1	Substitution
			98,200 2	State Water Rights	Sacramento River	3	
City of Sacramento	N/A	166,200	245,000	State Water Rights	American River	2	
			81,800	State Water Rights	Sacramento River	2	
SMUD	N/A	32,131 c, 2	30,000	CVP-M & I	American River	2	
Delta Lowlands	53,548 h, 6		10,700 i	Riparian	Delta Channels	2	
Placer County							
Placer County W.A.		5,000 a, 1	43,000	CVP-Ag	American River	2	
			74,000	CVP-M & I	American River	2	
			120,000	State Water Rights	American River	2	
Proposed Auburn Dam Reservoir			200,000	State Water Rights	American River	5	
Solano County							
Reclamation District No. 2068	13,200 1	45,000 a, 1	45,000 a, 1	State Water Rights	Sacramento River	2	
Delta Lowlands	57,167 h, 6		114,000 i	Riparian	Delta Channels	2	

The identification of a potential water supply source for the purposes of this study does not imply a willingness or an availability of resources on the part of an identified agency or project to develop a transferrable water supply for CCWD.

C-100011

Exhibit 4-7 (Continued)
Potential Water Supply Sources For Contra Costa Water District

Potential Source	Irrigated Acreage (Acres)	Annual Water Use (Acre-Feet)	Surface Water Supplies: Water Rights Entitlement (Acre-Feet)	Surface Water Supplies: Rights/Entitlement	Surface Water Supplies: Source	Surface Water Supplies: Supply Availability	Groundwater: Potential Groundwater Sources	Reclaimed Water: Amount (Acre-Feet)	Reclaimed Water: Reclamation Activity	Reclaimed Water: Discharge Point
[illegible]										
Contra Costa County										
Contra Costa W.D.		100,000	195,000	CVP-M & I	Rock Slough	2	Substitution			
			26,700	State Water Rights	Mallard Slough	2				
East Contra Costa I.D.		34,700	50,000	State Water Rights	Indian Slough	2	Substitution			
Byron-Bethany I.D.		40,000	40,000	State Water Rights	Clifton Court Forebay	2				
Delta Lowlands	18,872 h, 6		38,000 i	Riparian	Delta Channels	2				
Proposed Kellogg Reservoir			Unquantified j	State Water Rights	Unregulated Flows - Delta	5				
Sacramento River								26,700	Desalination of Mallard Slough rights	Contra Costa Canal
Mallard Slough								26,700	Desalination of Mallard Slough rights	Contra Costa Canal
Central Contra Costa Sanitary District								50,000	Wastewater Reclamation	CCCSD Wastewater Treatment Plant
Delta Diablo Sanitary District								19,000	Wastewater Reclamation	DDSD Wastewater Treatment Plant
Ironhouse Sanitary District								2,500	Wastewater Reclamation	
Brentwood Sanitary District								2,200	Wastewater Reclamation	
Contra Costa Sanitary District 19								1,300	Wastewater Reclamation	
Byron Sanitary District								100	Wastewater Reclamation	
Mountain View								Unknown	Wastewater Reclamation	
Alameda County										
East Bay M.U.D.		15,000	15,000	CVP-M & I	American River	2				
			15,000	State Water Rights	American River	4				
Bay Area Dischargers	N/A							400,000	Wastewater Reclamation for Agriculture	
[illegible]										
San Joaquin County										
Banta Carbona I.D.	20,000 1	50,000 a, 1	25,000 2	CVP-Ag	Delta Mendota Canal	1				
			148,000 1	Riparian Rights	San Joaquin River	2				
South San Joaquin I.D.	72,000 1	300,000 a, 1	300,000 a, 1	State Water Rights	Stanislaus River	2				
Woodbridge I.D.	13,000 1	116,700 a, 1	116,700 a, 1	State Water Rights	Mokelumne River	2				
				State Water Rights	Beaver Slough	2				
City of Tracy								30,000	Wastewater Reclamation	
Delta Lowlands	151,460 h, 6		303,000 i	Riparian	Delta Channels	2				
Delta Storage Reservoirs			Unquantified i	State Water Rights	Delta Channels	5				
Stanislaus County										
Oakdale I.D.	73,000 1	300,000 a, 1	300,000 a, 1	State Water Rights	Stanislaus River	2	Substitution	Unknown	Distribution Facilities Improvements	
Modesto I.D.	103,700 1	154,400 a, 1	154,400 a, 1	State Water Rights	Tuolumne River	2	Substitution			
Turlock I.D.	196,500	400,000 a, 1	400,000 a, 1	State Water Rights	Tuolumne River	2	Substitution			
City of Modesto								27,000	Wastewater Reclamation	
Merced County										
CVP Exchange Contractors			840,000 2	CVP Exchange,	Delta Mendota Canal	2				
San Luis Canal Company				State Water Rights						
Firebaugh Canal Co.										
Central California I.D.										
Merced I.D.	143,000 1	570,000 a, 1	570,000 a, 1	State Water Rights	Merced River	2	Substitution	Unknown	Distribution Facility Improvements	
Proposed Los Banos Reservoir			Unquantified j	State Water Rights	Delta	5				
Madera County										
Chowchilla W.D.	65,000 1		24,000 2	CVP-Ag	Buchanan Dam	2	Substitution			
			55,000 2	CVP-Ag Class I	Madera Canal	2				
			160,000 2	CVP-Ag Class II	Madera Canal	4				
Madera I.D.	116,800 1	135,000 a, 1	85,000 2	CVP-Ag Class I	Madera Canal	2	Subsitution			
			186,000 2	CVP-Ag Class II	Madera Canal	4				
			Unknown	State Water Rights	San Joaquin River	2				
			Unknown	State Water Rights	Fresno River	2				
Kern County										
Berrenda Mesa W.D.	49,900 1	130,000 a, 1	155,100 4	SWP-Ag	SWP - California Aqueduct	1				

The identification of a potential water supply source for the purposes of this study does not imply a willingness or an availability of resources on the part of an identified agency or project to develop a transferrable water supply for CCWD.

Notes/Footnotes
- a Annual water use
- b Contract entitlement
- c Maximum historical delivery
- d Solano County Conservation and Flood Control District
- e Irrigation of water fowl habitat and native pasture
- f Agricultural drain water collected and disposed
- g Ten-year average annual diversion
- h Annual crop acreage
- i Based on crop consumptive use of 2.0 feet
- j Annual yield of new reservoir is not projected

1 ACWA's 75 Year History
2 USBR contract sheet
3 Map--Boundaries of Public Water Agencies--San Joaquin Valley 1993 - DWR
4 Contract specific to agency sited
5 Based on previous, unpublished, B-E work for Yuba County Water Agency
6 DWR December 1993
7 USBR Facts Sheet

Supply Availability
1 Agricultural supply, availability primarily during irrigation season specific to crop type or contract.
2 Base water supply, available in all years subject to water shortage conditions.
3 CVP base supply, available primarily between April and October.
4 Wet year supply only.
5 Availability dependant on hydrological conditions.

ECCID boundaries. However, such an arrangement may be challenged by other water users if the water transferred has not been used by ECCID in recent history.

CCWD may also be able to arrange for a transfer to the CCWD service area of some of the ECCID water for which it has contracted and can currently be served only within ECCID boundaries. However, such an arrangement may be challenged by other water uses if the water transferred has not been used by ECCID in recent history.

Regional Availability of Groundwater Opportunities. Potential development of groundwater resources includes groundwater substitution, export and conjunctive use of surface water. Groundwater substitution, or exchange, involves transferring all or a portion of surface water entitlements and replacing the increment of transferred surface water with groundwater to irrigate crops. The surface water that would have otherwise been diverted for irrigation would then be transferred to CCWD. Implementing such a transfer would require identifying willing sellers and overcoming source area concerns about groundwater impacts such as overdraft, subsidence and the general distrust of some communities toward such programs.

Groundwater export provides the only type of groundwater development that offers an additional water supply source directly from groundwater. Groundwater export involves pumping groundwater directly into conveyance channels for delivery to CCWD intake facilities. Implementing a water transfer based on groundwater export would require identifying willing sellers and overcoming source area concerns about groundwater impacts similar to requirements for groundwater substitution identified above. Direct out-of-basin groundwater transfers in California are subject to a number of limitations, however. A major limitation on groundwater export is the superior right to groundwater of all overlying landowners. Water Code (§1220) places stringent requirements on the direct export of groundwater from the Sacramento and Delta-Central Sierra basins, requiring compliance with an adopted groundwater management plan. Finally, public opinion, particularly in the northern Sacramento Valley, is wary of groundwater pumping for out-of-basin transfers. Several counties in the Central Valley are exploring means of ensuring local control of groundwater resources.

Exhibit 4-8
Crop and Irrigated Acreage Within Hydrologic Regions of the Central Valley

	1990 (1) (thousands of acres)				2020 (thousands of acres)			
Irrigated Crop	Sacramento River	San Joaquin River	Tulare Lake	Total Central Valley	Sacramento River	San Joaquin River	Tulare Lake	Total Central Valley
Grain	303	182	297	782	295	179	258	732
Rice	494	21	1	516	482	15	0	497
Cotton	0	178	1,029	1,207	0	178	949	1,127
Sugar Beets	75	64	35	174	72	45	25	142
Corn	104	181	100	385	115	183	98	396
Other Field	155	121	135	411	158	122	130	410
Alfalfa	141	226	345	712	152	156	240	548
Pasture	357	228	44	629	320	171	22	513
Tomatoes	120	89	107	316	132	88	85	305
Other Truck	55	133	204	392	65	201	350	616
Almonds/Pistachios Other Deciduous	205	147	177	529	217	151	178	546
Citrus/Olives	18	9	181	208	29	11	190	230
Grapes	17	184	393	594	24	189	363	576
Total Crop Area	2,145	2,008	3,212	7,365	2,186	1,952	3,061	7,199
Irrigated Land Area	2,101	1,955	3,147	7,203	2,114	1,884	2,971	6,969

Notes. (1) Actual acreage values for 1990 were adjusted, based on averages of the 1980s, to reflect more normal water years and market conditions.
Source: California Department of Water Resources, 1994. Bulletin 160-94, California Water Plan Update, Volume I. 1994

Conjunctive use or planned groundwater storage involves intentional recharge of groundwater basins in wet years for subsequent extraction when needed. Conjunctive use can be practiced to a limited extent within the CCWD Service Area or at any location with adequate conveyance facilities to deliver water to CCWD. Development of conjunctive use opportunities does not produce water supplies, but instead offers a water banking opportunity that could allow CCWD to take advantage of seasonal or wet year supplies.

Exhibit 4-5 identifies potential groundwater development opportunities, particularly export and substitution scenarios, included in the FWSS. The regional availability of these alternatives is summarized below.

Northern Sacramento Valley. Much of the Sacramento Valley north of Yolo County has groundwater aquifers that are essentially full. Two areas offer exceptional potential for recharge and might be developed cooperatively with overlying entities. These areas are the Stony Creek Fan and the Thomes Creek Fan, in Glenn and Tehama counties, respectively.

Yuba County. Groundwater levels north of the Yuba River in Yuba County are high, and surface irrigation drains into the Feather River. There is active local interest to enter into conjunctive surface and groundwater operations to provide water for export.

Yolo County. Because groundwater levels are depressed in central Yolo County, the Yolo County Flood Control and Water Conservation District is actively seeking supplemental water. The district constructed Indian Valley Dam and Reservoir in the Cache Creek drainage for supplemental water and is evaluating political means of securing the extension of the authorized Tehama-Colusa Canal and diversions directly from the Sacramento River for irrigation. DWR continues to investigate the potential for groundwater banking in Yolo County.

Central Contra Costa County. Prior to the construction of the Contra Costa Canal, small quantities of groundwater were used in the central county basins of Ygnacio and Clayton Valleys. However, these supplies were not sufficient to support local uses, which led to the construction of the Contra Costa Canal. CVP supplies from the Canal have largely replaced groundwater pumping and current use is minimal. The current state of knowledge on the Ygnacio and Clayton Valleys is limited. Available studies indicate that the basins have total capacities of 40,000 and 20,000 ac-ft, respectively (Poland, 1935; CDM, 1980).

East Contra Costa County. Groundwater in the eastern portion of the county has been used primarily for domestic and rural residential purposes. Both the ECCID and the BBID have surface water rights from the Delta and have served irrigation water in the area for many years. Groundwater levels are generally high in these areas. Because the groundwater basin is close to the Delta, extensive use of these resources may induce saline water intrusion, a potential water quality issue. In addition, nitrate levels in the groundwater have posed a health hazard in recent years. Use of groundwater in this area would depend on assurances of an adequate supply for recharge and that groundwater levels would recover. Local jurisdictions are preparing a groundwater management plan.

Regional Availability of Reclamation Opportunities. Recycled water is wastewater that is reused rather than discharged by a wastewater treatment plant into receiving waters or to land disposal (wetlands or evaporation ponds, for example). Recycled water projects are therefore typically developed in conjunction with a wastewater utility. Recycled water can substitute for raw water or non-potable uses where appropriate, freeing up supplies for other consumptive uses and providing a drought-proof supply. Recycled water projects within the CCWD Service Area could conserve potable water supplies for existing and future users, while recycled water projects in other parts of the Central Valley could free up existing raw water supplies for transfer to CCWD. Potential sources are summarized below.

Recycled Water Sources in Contra Costa County. Wastewater treatment plants are the sources of recycled water. The District's existing Service Area overlaps portions of the Central Contra Costa Sanitary District (CCCSD) and the Delta Diablo Sanitation District (DDSD) wastewater district service areas.

- **Central Contra Costa Sanitary District.** CCCSD owns and operates a wastewater treatment plant (current rated capacity of 45 million gallons per day [mgd], with a projected 2040 flow of 46.7 mgd) immediately northeast of the Interstate 680 and Highway 4 intersection. The current average dry weather flow rate is 33.6 mgd, with the flow expected to increase to 39.2 mgd by the year 2000 (CDM, 1985). CCWD and CCCSD began planning studies for recycled water use by industries in the western half of the CCWD Service Area in 1969. Subsequent extensive studies identified a variety of potential uses and projects, including urban landscaping irrigation.

  An agreement reached between the District and CCCSD in October 1994 established a framework for either district to consider potential recycled water projects. If a project meets environmental, economic and other factors important to each district's business decisions, the agreement sets up a framework for either district to proceed alone if the other decides not to participate. The Zone 1 Project is underway by CCCSD to provide up to a maximum of 1,600 ac-ft/yr for irrigation; however, some of the water the project would replace is well water, and less than 1,000 ac-ft/yr of District supplies would be offset by the project.

- **Delta Diablo Sanitation District.** DDSD owns and operates a wastewater treatment plant (current rated capacity of 16.5 mgd, with a projected 2040 flow of 21.4 mgd) north of the Pittsburg Antioch Highway at the Pittsburg-Antioch border. The current average dry weather flow rate is approximately 11 mgd, with the flow expected to increase to 17.4 mgd by the year 2005. DDSD began planning studies for recycled water use in the eastern half of the CCWD Service Area in 1980; CCWD joined in these planning efforts. These planning studies evaluated both industrial water recycling and urban landscaping water recycling (JMM, 1989; JMM, 1990c).

Four smaller sources exist in the neighboring sanitation districts of Ironhouse, Brentwood, Discovery Bay (CCCSD No. 19) and Byron. Potential recycled water projects farther east in Contra Costa County have not been evaluated to the depth of projects in the CCCSD and DDSD service areas. Potential recycled water projects within these districts would involve coordination with one or more of the wastewater agencies, cities, water districts and counties. The current and projected 2040 average dry weather flow capacities of the treatment plants operated by each of these agencies is:

	Current	Projected (2040)
Ironhouse	2.2 mgd	8.0 mgd
Discovery Bay	1.2 mgd	2.4 mgd
Brentwood	2.0 mgd	11.0 mgd
Byron	0.05 mgd	2.4 mgd

Identification of Recycled Water Projects. Potential recycled water opportunities for CCWD include urban landscape irrigation projects, industrial reuse projects, agricultural irrigation projects, and groundwater recharge recycling projects. Most projects would require construction of water treatment and distribution facilities. Potential projects could be located throughout the District's current Service Area, as well as the Central Valley and San Francisco Bay Area. Following are brief discussions of the alternatives.

- **Urban Landscape Irrigation Projects.** These projects would supply recycled water for landscape irrigation. Potential irrigation sites include parks, schools, golf courses, median strips, business parks and homeowners' associations. Potential projects could be located in Central Contra Costa County, Pittsburg/Antioch, and East Contra Costa County.
- **Industrial Reuse Projects.** These projects would supply highly treated reclaimed wastewater to selected industrial customers for process and cooling purposes. In general, the industrial water recycling projects have a more constant demand than urban or agricultural irrigation water recycling projects. They also typically demand very high water quality, requiring tertiary and sometimes demineralized treatment. Potential customers include Shell and Tosco Refineries, USS-Posco and Dow Chemical.
- **Agricultural Irrigation Projects.** These projects would supply recycled water for agricultural irrigation. The recycled water could either be used directly on the fields, or as a groundwater recharge mechanism. Seasonal operation of recycled water treatment facilities would be needed for direct application, while the recharge option would result in a year-round operation of treatment facilities. Potential projects could be located within or outside the District's Service Area.
- **Groundwater Recharge Projects.** This type of recycled water project has not previously been evaluated within the CCWD Service Area but is being used in several locations in Southern California and in the Dublin-San Ramon and Livermore areas. In this type of project, a high level of recycled water treatment is provided, and the recycled water is injected into a groundwater aquifer. For example, Orange County Water District's Water Factory 21 provides lime clarification, filtration, Granular Activated Carbon (GAC) adsorption and disinfection to treat recycled water before injection into an aquifer to prevent seawater intrusion. A portion of the filter effluent is treated with reverse osmosis to lower the TDS concentration in the injected recycled water.

  While prevention of seawater intrusion is not a critical issue in the CCWD Service Area, a groundwater recharge recycled water project could be used for indirect potable reuse in critical periods. That is, a high level of recycled water treatment, similar to Water Factory 21, would be provided; the recycled water would be injected into a groundwater aquifer and withdrawn for potable use during critical flow periods.

Recycled Water Sources in the Central Valley. Several opportunities involving recycled water and water supply transfers exist outside the District's Service Area. CCWD could financially participate with other agencies to provide recycled wastewater to irrigate farmland. In exchange, CCWD would receive additional potable supplies. These potential projects would require transfer arrangements similar to those needed for surface water supplies. Potential opportunities exist with the Cities of Tracy and Modesto and the Central California Regional Water Recycling Program.

Desalination Opportunities. Desalination could be used as a potential source for either a firm or emergency supply. The contractual, permitting and water rights requirements may be different for a firm or emergency supply. Brine disposal and the quantity of water that goes to waste in the process are serious issues that need to be considered when developing desalination alternatives.

In addition, different desalination alternatives may provide different levels of service to some portions of the CCWD Service Area. Desalination plants could be constructed at several locations within the District's system using several alternative water supply sources. Because the water quality is different at each proposed source, the treatment requirements and unit costs would differ for each. Also, because of differences in location, each source would require different conveyance facilities to deliver water to treated water customers or to industrial users. The detailed configuration of the desalination alternatives would depend on the project purpose (e.g., firm supply, emergency supply), required capacity and site-specific parameters such as water quality. The following provides a qualitative description of each of the potential desalination alternatives.

Sacramento/San Joaquin River. This alternative would consist of a desalination plant using water from a Sacramento River intake (possibly at Antioch, Pittsburg or Bay Point) as a source of supply where quality is often better. The District's current water right at Mallard Slough could be amended to transfer the point of diversion to another river intake location. The desalination plant could be located near the existing City of Antioch river intake or a potential future intake at Pittsburg or Bay Point (this intake is one alternative under study in the District's Seismic and Reliability Improvement [SRI] Project). Water from this plant could be delivered to raw water customers or to the District's TWSA through construction of new conveyance facilities or modifications to existing conveyance facilities.

Mallard Slough. This alternative would consist of a desalination plant using water from the District's existing Mallard Slough intake as a source of supply. The District's current water right at Mallard Slough allows a diversion of up to 26,780 ac-ft/yr; however, in dry periods the amount would be limited to that available under License No. 3167 (total diversion 14,000 ac-ft/yr). Because the salinity at this intake location is frequently higher than the District's water quality objectives, the intake is rarely used in dry periods, and occasionally in other periods (averaging 142 days in wetter periods). The desalination plant could be located near the intake, near the Bollman Water Treatment Plant (at the terminus of the Mallard Slough raw water pipeline) or anywhere along the raw water pipeline alignment (however, if it is not located near the diversion point, industrial users along the pipeline would require a means for a freshwater supply). Water from this plant could be delivered directly to the District's TWSA through existing pipelines or delivered to other raw water customers through construction of new conveyance facilities or modifications to existing conveyance facilities. Construction of a desalination plant would allow the District to make more effective use of its existing water right.

Seasonal Availability and Transfer Considerations

A reconnaissance-level appraisal for water availability was assigned to each of the identified potential water supply sources. A majority of the supplies were identified as agricultural supplies available during the agricultural season. Potential supplies were also characterized as to their annual availability, with a majority of sources listed as base water supply, available in all years, but subject to water shortage conditions. Availability of other sources were listed as CVP base supply (available primarily between April and October), wet year supplies only, or those sources dependent on hydrological conditions on a year-to-year basis. Exhibit 4-7 identifies the availability of each of the surface water supplies. For the purposes of the FWSS, it is assumed that supplies from groundwater export, wastewater reclamation and desalination are available throughout the year in all year types. The availability characteristics are described below.

Seasonal Characteristics. Appropriative rights for direct diversion and use are generally limited to the season of beneficial use (i.e., the irrigation season for agricultural use or throughout the year for M&I use). Rights for diversion to storage are generally allowed throughout the year. Releases from storage are not normally prescribed in water rights permits and licenses, except indirectly as may be required for instream flows. Power contracts and flood control requirements prescribed by the U.S. Army Corps of Engineers also require release schedules.

The Bureau contracts call for submission and approval of annual schedules for delivery; the seasonal patterns are thereby fixed. Some Bureau contracts contain provisions for conversion of irrigation water to M&I water. Contracts for service from the Delta-Mendota and Tehama-Colusa Canals provide for a shutdown of deliveries during December and January for maintenance. However, records of deliveries show that water is delivered from the canals in every month.

Groundwater could be pumped for transfer throughout the year. Wastewater for recla-
4-30 mation from a municipality is nearly constant throughout the year although industrial processing can result in seasonal peaks.

Yearly Availability. Water supply conditions are the primary factors in yearly water availability. For areas served out of the Delta, however, pumping restrictions for endangered species and water quality will play an increasing role until a "Delta fix" is implemented. Similar restrictions may exist for some Delta tributaries.

The majority of sources would be subject to water shortage conditions. Assuming the District's recently amended CVP contract is representative of future CVP M&I contracts, M&I water users should expect to receive no less than 75% of their historical use in water shortage years. Other appropriated water would be available during normal and wet years. During dry years, availability would depend on the seniority of water rights and other contract terms. Conjunctive use projects could allow a water right holder to switch to the use of stored groundwater during a dry year and transfer contracted water during that year to a willing buyer such as the District.

Dry year availability of CVP water would be subject to irrigation contract shortages. The Bureau has used a 50% supply target for irrigation, but this amount is subject to availability of supply. CVP water users who also divert from the Sacramento River have had contract provisions for delivery of not less than 75% of their appropriated rights. The same is true for the CVP Exchange Contractors who divert from Mendota Pool at the end of the Delta-Mendota Canal.

Some sources would be available only during wet years, which could assist the District in incorporating a water banking program to supplement drought year supplies. Such programs would take advantage of surplus water of other agencies during wet years by storing water for use during later years when the District experiences drought year cutbacks in CVP supplies.

Exhibit 4-9
Comparison of Principal Transfer Considerations by Water Source

Transfer Considerations	Central Valley Project Water	Other Appropriated Water	Groundwater	Reclaimed Water
Seasonal Distribution	Irrigation season; some CVP "irrigation" contracts allow M & I use	Irrigation season for direct diversion rights; year-round for storage releases	Year-round	Year-round
Dry Year Availability	Subject to irrigation contract shortages	Depends on seniority rights and/or CVP/SWP/other contract terms	Available	Available
Regulation Mechanism	Conjuctive use with groundwater; groundwater banking, directly or by exchange	Conjunctive use with groundwater; groundwater banking, directly or by exchange	Not needed	Not needed
Transfer Pathway to CCWD from Out of District Sources	Natural channels if supply from north of Delta, but with Delta carriage water assessment; divert from Delta if supply from south of Delta	Natural channels if supply from north of Delta but with Delta carriage water assessment; need to exchange purchased water for south of Delta transfer with CVP or SWP contractor supplied from the Delta	Natural channels if supply from north of Delta but with Delta carriage water assessment; for south of Delta transfer, need to exchange purchased water with CVP or SWP contractor supplied	Natural channels if supply from north of Delta but with Delta carriage water assessment; for south of Delta transfer, need to exchange purchased water with CVP or SWP contractor supplied from the Delta
Institutional	Contract under provisions of CVPIA; CCWD has first right of refusal against a non-CVP purchaser	Need SWRCB approval on post-1914 water rights; may need contracts with third parties for banking and/or wheeling. SWRCB can validate pre-1914 rights, but not required	No approval by SWRCB required; may need third party wheeling contract	Likely need Regional WQCB discharge permit; may need diversion and place of use permit from SWRCB, but not for effluent from groundwater sources
"Real Water"	Transfer amount limited to net consumptive use and irretrievable losses	Transfer amount limited to net consumptive use if supply is from crop shift or fallowing; if from surface storage, transfer amount could be discounted by storage refill impacts on others	Total pumpage unless discounted for refill impacts	Total quantities, if no injury to other user

Groundwater could be pumped for transfer in dry years, given sufficient water quantities were stored during previous normal and dry years. Wastewater for reclamation from a municipality would be available at nearly the same levels in all years.

Principal Transfer Considerations. Exhibit 4-9 identifies the principal transfer considerations for each type of water source listed in Exhibit 4-7, which are related to water rights, institutional factors and availability of supply. The descriptions in Exhibit 4-9 apply to the broad range of potential water source categories. However, there may be exceptions for a particular source, which would usually be identified only in specific transfer negotiations.

Transferable quantities may be limited to consumptive use and irretrievable losses and, in the case of storage withdrawals, would be discounted by the amount of storage refill that was determined by the SWRCB to injure another lawful water user. For example, DWR and the Bureau, through the SWRCB water rights process, required Yuba County Water Agency to account for water that refilled storage space created by water transfers from storage releases. Similar requirements might be locally imposed for groundwater storage transfers.

POTENTIAL CONSERVATION COMPONENTS

Conservation programs reduce demand, thereby reducing water supply needs. Three Conservation Program Alternatives (CPAs) were developed as part of the FWSS. The three CPAs were designed to achieve increasing levels of demand reduction and meet requirements of the CVPIA Best Management Practices. This discussion focuses on long-term conservation programs only and does not examine drought demand reductions. It describes potential conservation measures, how these measures were combined to form CPAs, and the resulting conservation savings. Monitoring and evaluation of conservation savings and customer demand should be an ongoing effort to ensure that savings goals and BMP requirements are achieved. More detailed information can be found in Technical Appendix C.

Conservation Savings Irrespective of CCWD Programs

CCWD will realize future water conservation savings even if the District undertakes no additional conservation efforts. The demand projections presented in Chapter 3 include an estimate of conservation savings irrespective of CCWD programs. These savings from conservation, ranging between 6 and 10%, result from State and Federal regulations (excluding the BMPs) and the normal replacement of fixtures and devices with more efficient models.

Primary Assumptions

To adequately evaluate potential conservation measures and programs, a thorough understanding of the District's current and projected demand is necessary. Chapter 3 presents the demand projections and customer account information used to calculate conservation savings.

Demand within the District's treated water and wholesale service areas is generally comprised of five use categories: Single Family, Multi-Family, Commercial & Light Industrial, Landscape and Industrial. Typically, water use by Single Family, Multi-Family and Landscape customers is fairly uniform within each customer category. In contrast, Industrial and Commercial customers' water use varies significantly by account. Conservation measures were developed to provide conservation assistance to all customer categories. All conservation savings percentages presented in this discussion are for the year 2040.

Potential Conservation Measures

Measures are individual conservation practices, such as audits or rebate programs, that increase water use efficiency. The following measures were culled from the District's current conservation efforts, BMPs currently in effect and measures proposed in CVPIA and California Urban Water Conservation agreements:

- System operations and loss reductions
- Public information and education
- Pricing and incentives
- Ordinances and plan reviews
- Audits
- Ultra Low Flow Toilet (ULFT) Rebate Program

System Operations and Loss Reductions. This measure includes system operation upgrades that reduce water losses from seepage, evaporation and leaks. Canal lining, leak detection and repair, and corrosion control programs are all included under this measure.

Public Information and Education. This measure supports all other conservation efforts and is essential to the success of any conservation program. It includes implementing programs to promote water conservation including media announcements and campaigns, workshops, school presentations, newsletters and bill inserts; providing speakers to community groups; and coordinating with government agencies, industry and public interest groups.

Pricing and Incentives. The District's water rate structure provides customers with an economic incentive to keep water use low. Incentives such as rebates and give-aways have been incorporated into the other measures.

Ordinances and Plan Reviews. This measure includes the model landscape ordinance and water waste prohibition regulations. Water waste prohibitions are only as effective as public awareness and enforcement, both of which increase during water shortages. The effectiveness of model landscape ordinances and plan reviews also depends on enforcement, education and follow-up. Currently, much of this effort is outside of the District's control. However future programs will strive to include more District participation.

Audits. This measure incorporates audits of all major customer categories including Single and Multi-Family Residential, Commercial and Light Industrial, Landscape and Industrial. The audits include distribution and installation of interior plumbing features, leak detection, review of irrigation system performance, preparation of personalized irrigation schedules, distribution of education information and follow-up.

ULFT Rebate Program. This measure encourages replacement of Residential and Commercial non-efficient toilets with ULFTs. Rebates will be offered on a first come first served basis to qualifying customers.

Conservation Program Alternatives

As part of the FWSS, the District developed three CPAs (i.e., CPAs 1, 2 and 3) that result in a range of conservation savings between 5 and 12% in the year 2040. The CPAs include all measures described above; however, the level of effort expended by CCWD and its customers increases as one progresses from CPA 1 to CPA 3. Generally, the alternatives differ by relative savings achieved, voluntary versus mandatory controls, relative costs, reliability, technical feasibility and ease of implementation. The reliability and ease of implementation of the programs decrease as the level of effort increases. The DWR, the California Urban Water Conservation Council (CUWCC) and other agencies have all noted difficulties implementing more intensive conservation measures. Aggressive conservation programs may also be accompanied by a general hardening of demand, thereby reducing customers' ability to respond to future water shortages.

Conservation Program Alternative 1. CPA 1 is an expansion of the District's current conservation efforts to encompass wholesale and retail customers. It is consistent with currently mandated BMPs and achieves an overall District-wide reduction of 5% in the year 2040. This is in addition to the conservation savings irrespective of District programs estimated at between 6 and 10%.

Residential Savings. To determine the residential savings associated with CPA 1, indoor and outdoor water use were examined. It was concluded that the largest potential for reduction occurs in outdoor water uses. Consequently, the audit program will focus on increasing the efficiency of irrigation practices and systems and encouraging installation of water efficient landscaping. The ULFT Rebate Program will ensure that interior use is reduced as well. CPA 1 results in a 6% reduction in Single Family demand and a 5% reduction in Multi-Family demand.

Non-Residential Savings. With the exception of Landscape customers, water use by Non-Residential customers tends to vary significantly by account. Again, however, the largest potential for reduction occurs in exterior water uses. The audit program will include recommendations on how interior and exterior water use can be reduced. Since Landscape customers use more water outdoors, their demand will be reduced by 7% with CPA 1 and Commercial and Light Industrial customers' use will decrease by 5%.

Industrial Savings. Specialized audits will be conducted for Industrial customers to ensure their water using equipment and processes are adequately evaluated. These customers are already fairly efficient water users, so it is estimated that CPA 1 will reduce their use by 2.5%.

Conservation Program Alternative 2. CPA 2 is similar to CPA 1 but with higher coverage and participation levels; CPA 2 achieves an overall District-wide reduction of 9% in the year 2040. It requires considerable effort from CCWD and its customers. In CPA 2, the burden of responsibility for savings shifts, to a large extent, from CCWD to its customers. CCWD increases the coverage associated with the conservation measures, but customers are expected to achieve greater savings after exposure to the measures. Note that the savings identified below are in addition to the conservation savings irrespective of District programs.

Residential Savings. Single Family savings increase from 6% in CPA 1 to 10% in CPA 2; Multi-Family savings increase from 5 to 9%. These savings are largely realized through increased coverage and acceptance of the Audit Program and increased adherence to the Model Landscape Ordinance.

Non-Residential Savings. Commercial and Light Industrial customers will reduce use by 9% in CPA 2 and Landscape water users will reduce use by 12%.

Industrial Savings. CCWD will double its audit program efforts for Industrial customers and anticipates increasing savings to 4%.

Conservation Program Alternative 3. CPA 3 is the most aggressive conservation program, with very high coverage and participation levels. It achieves an overall District-wide reduction of 12% in the year 2040. It places a large burden on CCWD and its customers and is considered the least reliable alternative due to the high coverage requirements and the resulting demand hardening. CPA 3 introduces rate structure changes and efficiency standards for commercial and industrial processes. It results in double-digit conservation savings from all customer categories, except Major Industrial. Once again, these savings are in addition to the conservation savings calculated irrespective of District programs.

Residential Savings. Single and Multi-Family customers' water use will be reduced by 14 and 13%, respectively.

Non-Residential Savings. Commercial and Light Industrial customers must achieve a 13% demand reduction, and Landscape customers will have to reduce use by 18%.

Industrial Savings. Industrial customers will be required to achieve a 6% reduction in future demand. These customers have significantly reduced their water use in recent years and therefore have the least potential for further demand reduction. The 6% reduction may be more difficult for Industrial customers to achieve than the 18% reduction expected from Landscape customers.

CONCLUSIONS

The District's water supply has historically provided safe and reliable water service to customers in Contra Costa County. To ensure the District will continue to provide high quality water service through the year 2040, CCWD investigated water supply improvements and demand management programs. A wide variety of potential supplemental water sources (a total of 84) exists throughout the Sacramento-San Joaquin River basins and the District's service area. These potential water sources include water transfers and exchanges, groundwater, water use reductions by others, water recycling and desalination. In addition, conservation will play a crucial role in meeting future demand.

As part of the FWSS process, the District examined these potential supply sources in detail, assembling Resource Alternatives from the water supply and conservation building blocks identified in this chapter. Chapters 5 and 6 describe the District's process of defining and screening the potential Resource Alternatives, as well as identifying a Recommended Preferred Alternative to meet future demand.

5. Initial Evaluation of the Resource Alternatives

OVERVIEW

After examining future demand and supply, the District developed Resource Alternative strategies to meet normal and drought year demands in the three Service Areas (C, E, and F) for three planning targets (2000, 2020 and 2040). During the Round 1 evaluation of potential Resource Alternatives, three separate strategies were developed that emphasize new water supplies, reclamation and conservation; Round 1 evaluation examined these three strategies, rating each against an established set of criteria that considered cost, implementability, reliability, and environmental impacts. Technical Appendix B outlines the criteria and rating guidance in further detail. The findings from this initial evaluation were used in a second round of evaluation to determine the most feasible and beneficial mix of demand management and supply components for the Recommended Preferred Alternative, as addressed in Chapters 6 and 7.

RESOURCE PLANNING

As detailed in Chapters 2 through 4, current supplies alone are not sufficient to meet all future needs. To minimize costs and environmental impacts, the District must maximize its existing supply contracts. However, the existing CVP supply contract, even when coupled with demand management, will not meet all future needs; a resource plan that includes a mix of components is required. Integrated Resources Planning ensures that increasing demand is met with a balanced mix of individual demand-side management and supply-side options. To consider a range of potential resources and achieve the most appropriate and reliable supply, the District's resource planning must be flexible and provide for evolution over time.

Resource Alternatives for three Service Areas (C, E and F, discussed in Chapter 3) were evaluated in the FWSS. Service Area C represents the planning area of the District's existing customers. These Service Areas represent three distinct service areas for which projected normal year demands differ by 20,000 ac-ft between Service Areas C and F in the year 2000, increasing to 80,000 ac-ft in the year 2040. A selection of resource components to meet projected demand for each of the three Service Areas, are referred to as Resource Alternatives. The Resource Alternatives for the larger Service Areas (E and F) provide the basis for developing regional solutions for East County water supply issues, and do not represent plans for service by the District. The East County Phase II Water Supply Management Study conducted under the direction of the East County Water Management Association examines future supply and conveyance issues for East County.

Also concluded from the demand and supply analysis in Chapters 3 and 4 was the need to plan not only for normal demand conditions, but for drought conditions as well. Although demands were assumed to be the same in dry years as under normal conditions, the need for supplemental or new supplies increases during droughts because of reductions of the District's CVP supply during those years. The Resource Alternatives have been designed to meet normal demands, 100% of demands in a drought condition and 85% of demands in a drought condition.

Exhibit 5-1
Demand Scenario

Planning Year	Service Areas	Year Type (DM) (a)	Demand to be Met(e) (TAF)	CVP Supply (TAF)	ECCID Transfer (TAF)	Additional DM/Supply Req'd (TAF)
2000	C	Normal (0) (f)	176	176	0	0
		Drought (0)	176	132(b)	0	44
		Drought (15%)	150	132	0	18
2000	E	Normal (0)	185	163	9(c)	0
		Drought (0)	185	132(b)	9	44
		Drought (15%)	157	132	9	16
2000	F	Normal (0)	194	185	9	0
		Drought (0)	194	139(b)	9	44
		Drought (15%)	165	139	9	17
2020	C	Normal (0)	210	166	0	44
		Drought (0)	210	140(d)	0	70
		Drought (15%)	179	140	0	39
2020	E	Normal (0)	237	166	21	50
		Drought (0)	237	140	21	76
		Drought (15%)	201	140	21	40
2020	F	Normal (0)	273	185	21	86
		Drought (0)	273	140	21	112
		Drought (15%)	201	140	21	71
2040	C	Normal (0)	217	166	0	51
		Drought (0)	217	140	0	77
		Drought (15%)	184	140	0	44
2040	E	Normal (0)	248	166	21	61
		Drought (0)	248	140	21	87
		Drought (15%)	211	140	21	50
2040	F	Normal (0)	297	166	21	110
		Drought (0)	297	140	21	136
		Drought (15%)	252	140	21	91

(a) DM, or Demand Management, is the percent of demand reduction required if supplies are assumed to be insufficient for full demand.

(b) 75% of contract historical use (contract "historical use" does not include ECCID supplies).

(c) ECCID transfer water of up to 15,000 ac-ft annually would be available by the year 2000. However, demand within the ECCID service area in the year 2000 is only projected to be 9,000 ac-ft annually.

(d) 75% of contract historical use (includes CVP and normal year river diversions).

(e) Demand levels were calculated irrespective of the source of supply, and exclude the effects of drought on water use. See "Comparison of Actual Sales and Projected Water Use" at the end of Chapter 3.

(f) Some of the total Service Area demands are met by non-CCWD supplies in normal years. This is the maximum CCWD would need to meet in those years.

While projected demands in Exhibit 5-1 are shown the same for normal and drought years, there is a higher demand for CCWD supplies during a drought year, as noted in Chapter 3. This is because a portion of Service Area demands may be met through other supplies (water diversions) in normal and wet years, which are unavailable during dry years.

The projected demands for each Service Area in the three target year conditions are summarized in Exhibit 5-1. Also shown are the projected supplies from existing sources and the resulting need for additional demand management and/or supply.

EVALUATION PROCESS

Resource Alternatives were developed and screened in two separate rounds. Round 1 developed three Resource Alternatives that each emphasized one of three resource strategies: New Supply, Reclamation and Conservation. Additionally, the Round 1 Resource Alternatives reflect the implications of varying supply sources on the District's CVP supply during dry years. The District assembled the most promising components identified in Round 1 to develop Round 2 Resource Alternatives.

The District evaluated the Round 1 Resource Alternatives based on the cost, reliability, environmental and implementability criteria summarized in Exhibit 5-2. A detailed description of the criteria and the guidelines used to evaluate each criterion is included in Technical Appendix B.

Exhibit 5-2
Evaluation Criteria

Criteria	*Objective*
Operation	
(O1)	Minimize water shortages (frequency and amount)
(O2)	Maximize water system reliability
(O3)	Maximize the quality and treatability of source waters
Economic	
(Ec1)	Minimize lifecycle costs
(Ec2)	Minimize rate impacts to customers
(Ec3)	Minimize indirect economic impacts to customers
Environment	
(En1)	Minimize environmental impacts to aquatic habitat, (including threatened and endangered species)
(En2)	Minimize environmental impacts to special status terrestrial species and wetland resources
(En3)	Minimize impacts to the community
Implementability	
(I1)	Maximize the seniority of water rights
(I2)	Minimize institutional barriers and risk of delay
(I3)	Ensure proper timing and phasing

Exhibit 5-3 illustrates the overall process for alternatives development which occurred on two parallel tracks. Development and evaluation of the Resource Alternatives is shown down the left side and the definition and screening of water transfers, discussed further in Chapter 6, on the right. The development of the Resource Alternatives in Round 1 occurred simultaneously with the evaluation of individual water transfers. The individual water transfers were studied on a separate track because of the range of variables associated with water transfers from different sources. Based on the separate evaluation of potential water transfers, the District identified the six most promising candidates from the list of 84 potential water transfer sources for integration in Round 2. The most influential factors in developing a shortlist of water transfer candidates include availability on the water market, quantity, delivery schedule and implementability. Technical Appendix D presents a detailed analysis of specific pathways, streamflow changes, and the optimization of operational needs for potential transfers. Actual negotiations, permitting and the approval process for a particular transfer would occur as a part of actual development and implementation of the Preferred Alternative, as discussed in further detail in Chapters 6 and 7.

Key Demand and Existing Supply Assumptions

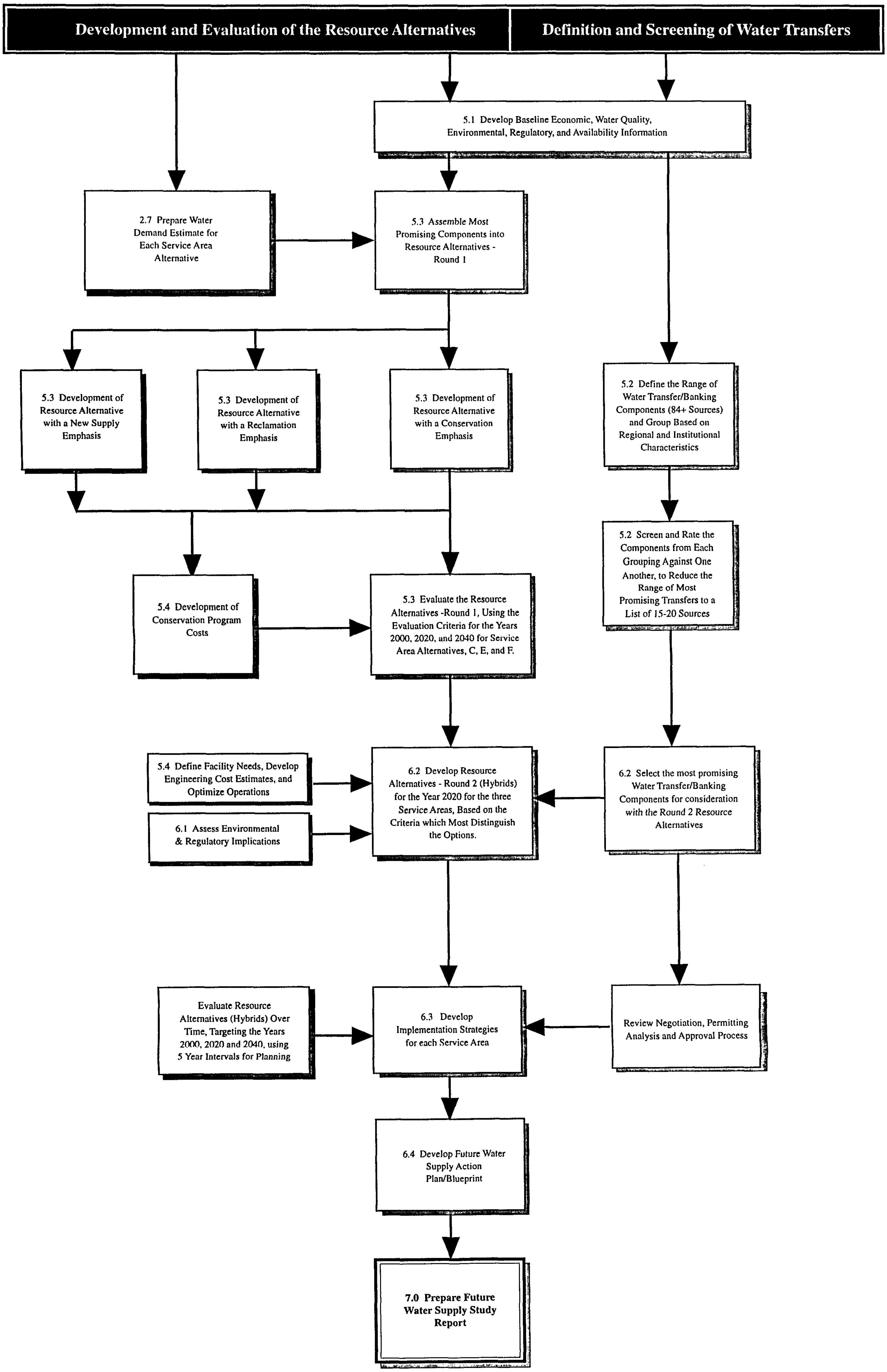
Due to the large number of possible demand and existing supply conditions, a set of probable conditions was established when developing Round 1 Resource Alternatives. These conditions, or key assumptions, include:

- **Water Supply Assumptions.** Based on the District's amended contract, the quantity of CVP water was designated within each Resource Alternative. As explained below, conditions considered included normal and drought year allocations, and the potential future reduction in CVP entitlement reductions to meet the environmental needs of the CVPIA.
- **Normal Year Supply.** The 1994 Amendatory Contract is effective through December 31, 2010 and provides that the Bureau will supply up to 195,000 ac-ft annually, available to CCWD at Rock Slough. The contract also contains provisions for an additional diversion point (the total contract quantity remains the same) on Old River to supply water to the Los Vaqueros Reservoir as well as directly to the CCWD Service Area. Diversions of the San Joaquin River stemming from the District's water right at Mallard Slough, as well as other municipal and industrial water rights held by District customers, are included within the District's historical use calculations during regulatory restricted and drought years.

In the analysis, CVP supplies in a normal year are used to encompass CVP supplies, as well as river diversions that may be available in a normal year, but are not reliable.

- **Drought Year Supply.** In a drought scenario, the Bureau can reduce the District's CVP water to not less than 75% of the contract entitlement or 85% of historical use (whichever is less). In severe droughts, it can be reduced to 75% of historical CVP water use. Conservation and reclamation play an important role in calculating the District's CVP allotment. In the District's contractual agreement with USBR, the quantity of water allocated to CCWD in times of shortage is a function of historical use; conservation and reclamation therefore reduce use and result in a smaller allocation. The District, in using such components, only marginally reduces the shortage in droughts. In addition, the District's water rights at Mallard Slough, as well as other municipal and industrial water rights held by District customers, are unusable during dry periods due to high salinity.
- **Historical Use.** CVP allotment for a drought is based on 75% of historical use (if demand is less than the contract amount plus river diversions), and 75% of the CVP contract plus normal year river diversions (if demand is greater than the contract amount). Historical use under the contract is CVP supplies, plus river diversions of Gaylord, Antioch and Mallard Slough. It does not include reclamation supplies, and conservation results in a reduced use.

Exhibit 5-3
Alternatives Development Process



- **CVP Improvement Act.** The CVPIA could reduce future supplies by as much as 15 to 20%, providing CCWD in 2010 with only 156,000 to 166,000 ac-ft per year of CVP water during a normal year. It is assumed, for planning purposes, that a CVPIA reduction of 15% of the contract amount would start by 2010 when the District's contract for CVP water expires, or perhaps sooner upon contract renewal. Resource Alternative calculations developed for the year 2000 are not affected.
- **Average Demand.** Resource Alternatives solve for average demand during a drought and a normal year.
- **Range.** A range is used in solving for a drought year, with need equal to 85% to 100% of historical demand.
- **Customer Reductions.** In matching 85% of demand calculated for a drought year, it is assumed the remaining shortage would be met through Service Area-wide reductions by all customers.
- **ECCID Transfer.** The ECCID transfer amount is not reduced during a drought year (based on its pre-1914 water rights).
- **Non-Canal Supplies.** Non-canal supplies (approximately 20 TAF) currently used by District customers (Antioch, Gaylord and Mallard Slough) are not considered reliable for planning purposes, but could be considered as a portion of the solution under the Surface Water Transfers/Groundwater Export component category in a normal year.

Development of Resource Categories and Components

Chapter 4 summarizes the District's existing supplies and the potential demand management and supply options. These options were defined as components to be combined into three water supply, conservation and reclamation categories to meet the requirements of the demand scenarios. Exhibit 5-4 displays the resource categories, developed as the Round 1 Resource Alternatives, identifying their respective components (also called building blocks).

Exhibit 5-4
Resource Categories and Components

Resource Category	Component
Water Supply	• CVP Water • Surface Water Transfers/Groundwater Export • Water Banking/Storage • Desalination
Conservation	• Conservation Program Alternative 1 • Conservation Program Alternative 2 • Conservation Program Alternative 3
Reclamation	• Agricultural Irrigation East County (8,800 ac-ft/yr) • Urban Irrigation Central County (3,800 ac-ft/yr) Pittsburg/Antioch (5,940 ac-ft/yr) East County (5,800 ac-ft/yr) • Industrial Use Shell/Tosco Industrial Process Use (25,300 ac-ft/yr) USS-POSCO/Dow /Gaylord Industrial Process Use (10,100 ac-ft/yr)

Chapter 4 defined the resource components by the potential percent reduction of demand or quantity of new supply, any constraints or restrictions in acquiring that supply, and the component's interdependency with another source of supply, including the District's CVP supply. These constraints and the operational, economic and implementation criteria (presented in Technical Appendix B) are used to differentiate between the resource groups and to screen out less desirable components from further evaluation. A summary of the main points discussed in Chapter 4 that pertain to the Round 1 evaluation is presented below.

Water Supply Resource Category. CVP supplies are the single-most important component within each of the Resource Alternatives. CVP supplies are capable of meeting the majority of demand for all three Service Areas in the year 2040. The CVPIA could reduce the District's entitlement by 15% by the year 2010, or as early as the year 2000. This could reduce future CVP supplies to 166 TAF per year during a normal year, rather than the current contract amount of 195 TAF per year.

Water transfers were investigated to develop supplemental supplies for the District, especially during dry years and the summer season when demand is high. A refined list of six potential sources was developed through the separate water transfer screening track (see Chapter 6). Groundwater export and water banking could also be an integral component of such a transfer depending on the quantity and timing required. Such a combination could increase flexibility of delivery schedules, and be beneficial in storing water transfers during wet and normal years to provide supplemental supplies during a drought.

The existing contract for transfer water with the ECCID was listed separately from
5-8 Surface Water Transfers/Groundwater Export component grouping and is considered a
primary building block in meeting demand for Service Areas E and F. CCWD maintains an existing contract for 21 TAF, which would provide a stable and consistent supply for M&I customers in the East County. At this time it would only be used in ECCID's boundaries. The contracted amount is not included within the District's historical use figure when determining CVP allocation. It is expected that by the year 2000, there would only be enough development to necessitate a demand for 9 TAF of the 21 TAF contract total.

Specific water transfer sources presented in Chapter 4 are not identified for this initial evaluation of the Round 1 Resource Alternatives. However, the Round 1 evaluation did determine the new supply quantities needed for each of the demand scenarios and the three resource categories (see Exhibits 5-5 through 5-17).

Desalination was also considered a potential supply component. Desalination would enable the District to benefit from an existing water right, and assist in meeting customer demand during a dry year. This method could be used to develop a continuous or emergency supply but appears to be most cost effective for continuous use. However, it was acknowledged that implementation of such a water resource is not likely to occur by the year 2000 due to environmental and regulatory conditions that would need to be met prior to construction; therefore, this component was included as an option only in the decades 2020 and 2040. The District would need to proceed with the implementation of such a project a number of years prior to activation.

Conservation Resource Category. Three conservation programs of varying intensity were developed, establishing a framework for evaluating a range of potential water savings options. The three CPAs are discussed in detail in Chapter 4 and Technical Appendix C. Calculating net savings for any of the conservation programs requires subtracting those savings already assumed through the No Action program. The No Action program acknowledges the potential level of savings that should occur irrespective of District efforts (or those of its wholesale customers).

Reclamation Resource Category. Specific reclamation projects, such as industrial use for cooling towers and specific urban irrigation projects for landscaping, were viewed as potential means to meet demand as soon as the year 2000. Reclamation would be beneficial during all seasons and water year types, providing a consistent supply that would free up other potable supplies for more selective use. Some projects were not considered feasible until the target years 2020 and 2040 because of required construction and/or the recycled water source will not achieve sufficient outflow levels to meet demands until a later date. The primary components, explained in more detail in Technical Appendix D, assumed the maximum estimated amount of recycled water would be available, annually. Simply adding the potential recycled water uses listed in Exhibit 5-4 overstates the potential for reclamation for a number of reasons. First, the two East County projects--Agricultural Irrigation and Urban Irrigation--are mutually exclusive; there is not enough treatable source water to provide for both. Second, source supply for the East County alternatives currently is limited (4,000 ac-ft/yr) but will increase as growth occurs in that area.

Round 1 Alternatives

The following presents three Round 1 Resource Alternatives, which maximize the components in each of the three resource strategies (New Supply, Reclamation and Conservation). The combinations of components to create Resource Alternatives, for each of the normal and drought year conditions, are described in the following sections and shown in Exhibits 5-5 through 5-7 for the years 2000, 2020 and 2040.

New Supply Emphasis. The New Supply emphasis maximizes surface water transfers/ rights and desalination. The significant increase in needed supplies within each demand scenario for the drought conditions reflects the potential decrease in CVP supply shown in Exhibit 5-1. Most of the supply need was met with surface water transfers, and the remainder with the maximum quantity of desalination at Mallard Slough and a moderate level of conservation (CPA 1). Exhibit 5-8 illustrates the method used to calculate the surface water transfers required for Service Area C in the year 2000.

Use of desalination at the District's Mallard Slough diversion point results in no net increase in water supply during drought years due to an offsetting deduction from the District's CVP allotment. Because of the shortage provisions within the District's CVP contract, desalination of the Mallard Slough supply would be beneficial to the District primarily if it is used during normal years, but is of little help in dry years. However, desalination was integrated into Service Area F in 2020 and all the resource options in 2040 to fully evaluate the New Supply emphasis. The desalination component would be operated continuously regardless of year type (normal or drought). The larger (20 mgd) reverse osmosis (RO) plant was assumed in all desalination scenarios to use the full quantity permitted for diversion at Mallard Slough, as well as the cost effectiveness of the larger facility.

In addition to new supply and desalination, a low conservation level (i.e., CPA 1) was integrated into Service Area F for the years 2020 and 2040 under the New Supply emphasis. Water saved through long-term conservation results in an equal reduction in CVP supply. A graphic display of the components used are included in Exhibit 5-9 through 5-13. Only one service area is shown on each of the Exhibits due to the similarities among components between Service Areas C and E.

Exhibit 5-5
Resource Alternatives - Round 1

Year 2040

Year 2020

Year 2000

Service Area Alternatives	THEMES: New Supply Emphasis	Reclamation Emphasis	Conservation Emphasis
	Drought/Normal	Drought/Normal	Drought/Normal
C 176 TAF	• CVP[1] (132/176 TAF) • Surface Water Transfers/Rights (18-44 / 0 TAF)	• CVP (122/163 TAF) • Industrial Process Use (12 / 12 TAF) • Central County Urban (1 / 1 TAF) • Surface Water Transfers/Rights (15-41 / 0 TAF)	• CVP (128/171 TAF) *[Conservation Program 3 (5/5 TAF)]* • Surface Water Transfers/Rights (17-43 / 0 TAF)
E 185 TAF	• CVP (139/185 TAF) • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (9-37 / 0 TAF)	• CVP (129/172 TAF) • Industrial Process Use (12 / 12 TAF) • Central County Urban (1 / 1 TAF) • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (8-34/ 0 TAF)	• CVP (134/179 TAF) *[Conservation Program 3 (6/6 TAF)]* • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (9-36 / 0 TAF)
F 194 TAF	• CVP (146/194 TAF) • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (10-39 / 0 TAF)	• CVP (136/181 TAF) • Industrial Process Use (12 / 12 TAF) • Central County Urban (1 / 1 TAF) • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (9-36/ 0 TAF)	• CVP (141/188 TAF) *[Conservation Program 3 (6/6 TAF)]* • ECCID Transfer (9/0 TAF) • Surface Water Transfers/Rights (10-38 / 0 TAF)

1. "CVP supplies" referred to in a normal year encompass CVP supplies and other supplies if available, but the District must be prepared to meet the full amount in any year.

Exhibit 5-6
Resource Alternatives - Round 1

Year 2040

Year 2020

Service Area Alternatives	THEMES: New Supply Emphasis	THEMES: Reclamation Emphasis	THEMES: Conservation Emphasis
	Drought/Normal	**Drought/Normal**	**Drought/Normal**
C 210 TAF	• CVP[1] (163/195 TAF) • Surface Water Transfers/Rights (15-47 / 15 TAF)	• CVP (128/171 TAF) • Industrial Process Use (35 / 35 TAF) • Central County Urban (4 / 4 TAF) • Surface Water Transfers/Rights (12-43 / 0 TAF)	• CVP (137/183 TAF) *[Conservation Program 3 (27 / 27 TAF)]* • Surface Water Transfers/Rights (15-46 / 0 TAF)
E 237 TAF	• CVP (163/195 TAF) • ECCID Transfer (21 / 21 TAF) • SurfaceWater Transfers/Rights (17-53 / 21 TAF)	• CVP (149/195 TAF) • Industrial Process Use (35 / 35 TAF) • Central County Urban (4 / 4 TAF) • ECCID Transfer (13-21 / 3 TAF) • Surface Water Transfers/Rights (0-28 / 0 TAF)	• CVP (155/195 TAF) *[Conservation Program 3 (31 / 31 TAF)]* • ECCID Transfer (15 / 11 TAF) • Surface Water Transfers/Rights (0-30 / 0 TAF)
F 273 TAF	• CVP (153/195 TAF) *[Conservation Program 1 (8/8 TAF)]* • Mallard Slough Desalination (10 / 22 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfer/Banking (40-81 / 27 TAF)	• CVP (163/195 TAF) *[Conservation Program 1 (8/8 TAF)]* • Industrial Process Use (35 / 35 TAF) • Central County Urban (4 / 4 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (1-42 / 10 TAF)	• CVP (163/195 TAF) *[Conservation Program 3 (35 / 35 TAF)]* • ECCID Transfers (21 / 21 TAF) • Surface Water Transfers/Rights (13 - 54 / 22 TAF)

1. "CVP supplies" referred to in a normal year encompass CVP supplies and other supplies if available, but the District must be prepared to meet the full amount in any year.

Exhibit 5-7
Resource Alternatives - Round 1

Year 2040

Service Area Alternatives	THEMES: New Supply Emphasis	THEMES: Reclamation Emphasis	THEMES: Conservation Emphasis
C 217 TAF	**Drought/Normal** • CVP[1](153/195 TAF) • Mallard Slough Desalination (10 / 22 TAF) • Surface Water Transfers/Rights (21-54 / 0 TAF)	**Drought/Normal** • CVP (134/178 TAF) • Industrial Process Use (35 / 35 TAF) • Central County Urban (4 / 4 TAF) • Surface Water Transfers/Rights (11-44 / 0 TAF)	**Drought/Normal** • CVP (141/188 TAF) *[Conservation Prog. 3 [29 / 29TAF)]* • Surface Water Transfers/Rights (14-47 / 0 TAF)
E 248 TAF	• CVP (153/195 TAF) • Mallard Slough Desalination (10 / 22 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (27- 64 / 10 TAF)	• CVP (152/195 TAF) • Industrial Process Use (35 / 35 TAF) • Central County Urban (4 / 4 TAF) • East County Ag. (6 / 6 TAF) • ECCID Transfer (14-21 / 8 TAF) • Surface Water Transfers/Rights (0-30 / 0 TAF)	• CVP (161/195 TAF) *[Conservation Prog. 3 (34 / 34 TAF)]* • ECCID Transfer (17-21 / 21 TAF) • Surface Water Transfers/Rights (0-33 / 0 TAF)
F 297 TAF	• CVP (153/195 TAF) *[Conservation Prog. 1 (12/12 TAF)]* • ECCID Transfer (21 / 21 TAF) • Mallard Slough Desalination (10 / 22 TAF) • Surface Water Transfer/Banking (56-101 / 47 TAF)	• CVP (163/195 TAF) *[Conservation Prog. 1 (12/12 TAF)]* • ECCID Transfer (21 / 21 TAF) • Industrial Process Use (35 / 35 TAF) • East County Ag. (10 / 10 TAF) • Central County Urban (4 / 4 TAF) • Surface Water Transfers/Rights (7-52 / 20 TAF)	• CVP (163/195 TAF) *[Conservation Prog. 3 (41 / 41 TAF)]* • ECCID Transfers (21 / 21 TAF) • Surface Water Transfers/Rights (34-72 / 40 TAF)

1. "CVP supplies" referred to in a normal year encompass CVP supplies and other supplies if available, but the District must be prepared to meet the full amount in any year.

Exhibit 5-8
New Supply Conditions

Year 2000 - Service Area C

Projected Demand: 176 TAF
- High End of Demand Envelope: 188 TAF
- Low End of Demand Envelope: 167 TAF

New Supply Emphasis

- Surface Water Transfers
- Surface Water Rights (New)

To Meet Demand of:	100%		85%	
Water Year Type	Normal	Drought	Drought	
Base Demand (TAF)	176	176	176	
Acceptance of Short-term Demand Management During Drought:			-26	(15% of 176)
Target Demand	176	176	150	(85% of 176)
Supply				
CVP	176	132	132	(75% of 176)
Surface Water Transfer	0	44	18	
Totals	176	176	150	(85% of 176)

Note: All figures in Thousand Acre-Feet (TAF).

5-13

Exhibit 5-9
Resources for Supply Needs in the Year 2000
for Service Area F

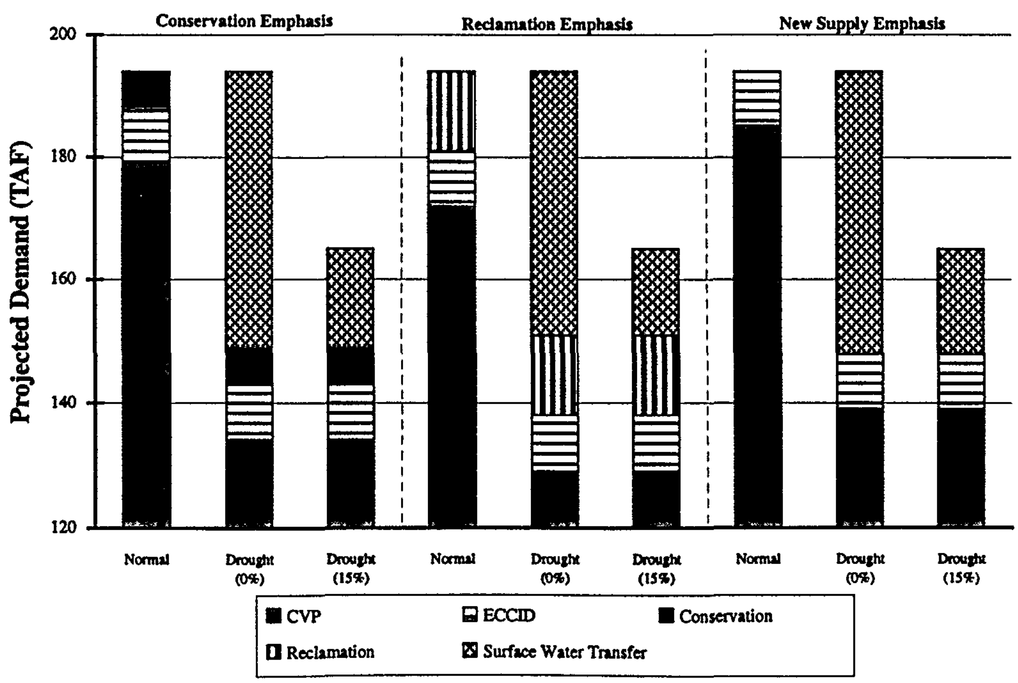
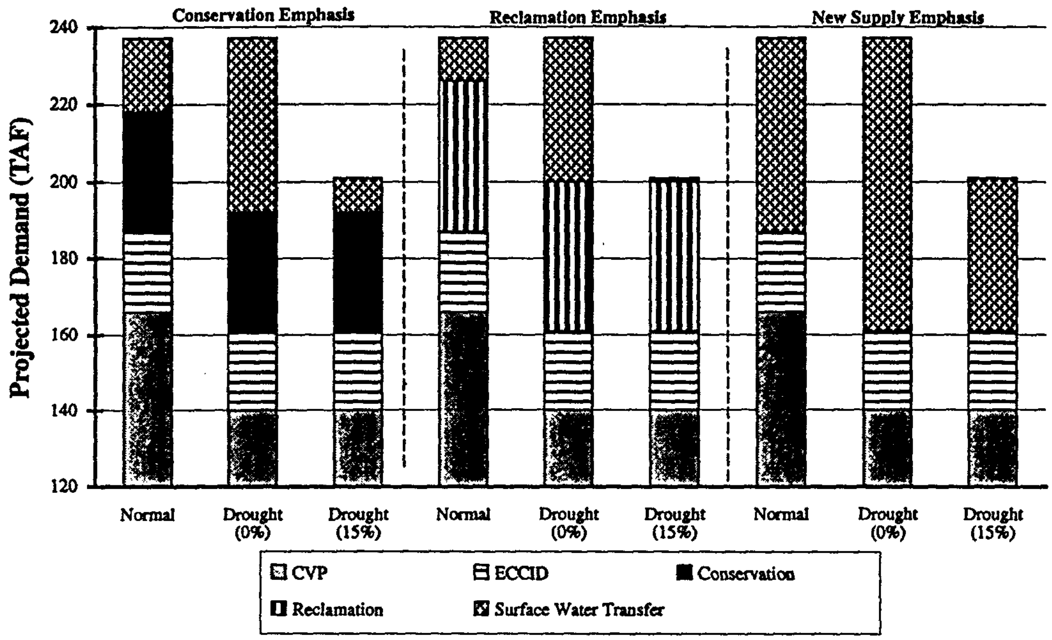


Exhibit 5-10
Resources for Supply Needs in the Year 2020
for Service Area E



-14

Exhibit 5-11
Resources for Supply Needs in the Year 2020
for Service Area F

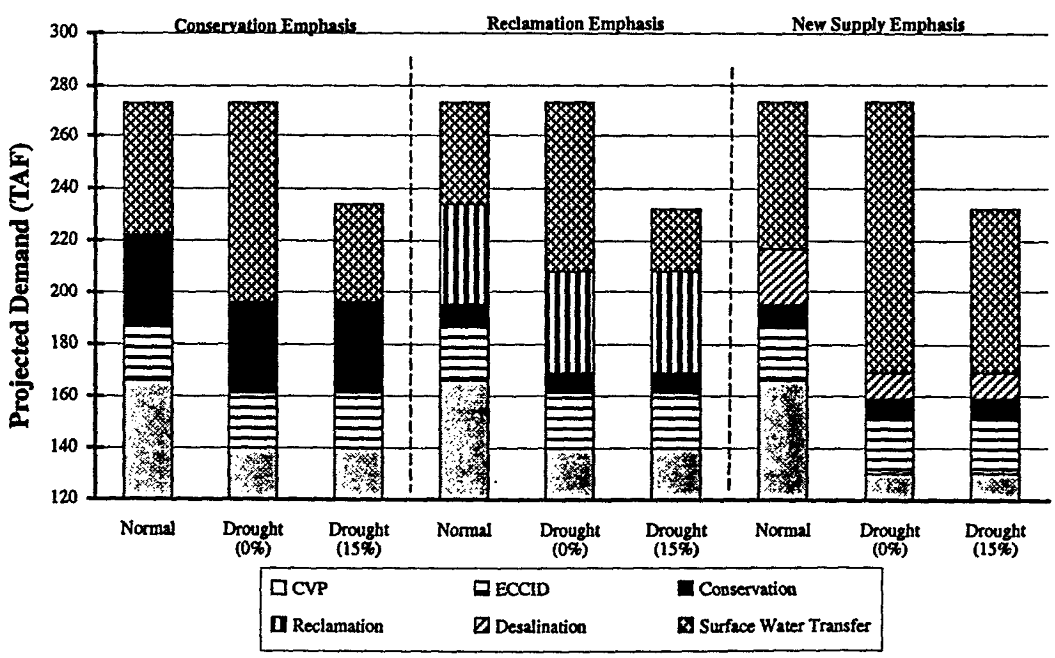


Exhibit 5-12
Resources for Supply Needs in the Year 2040
for Service Area E

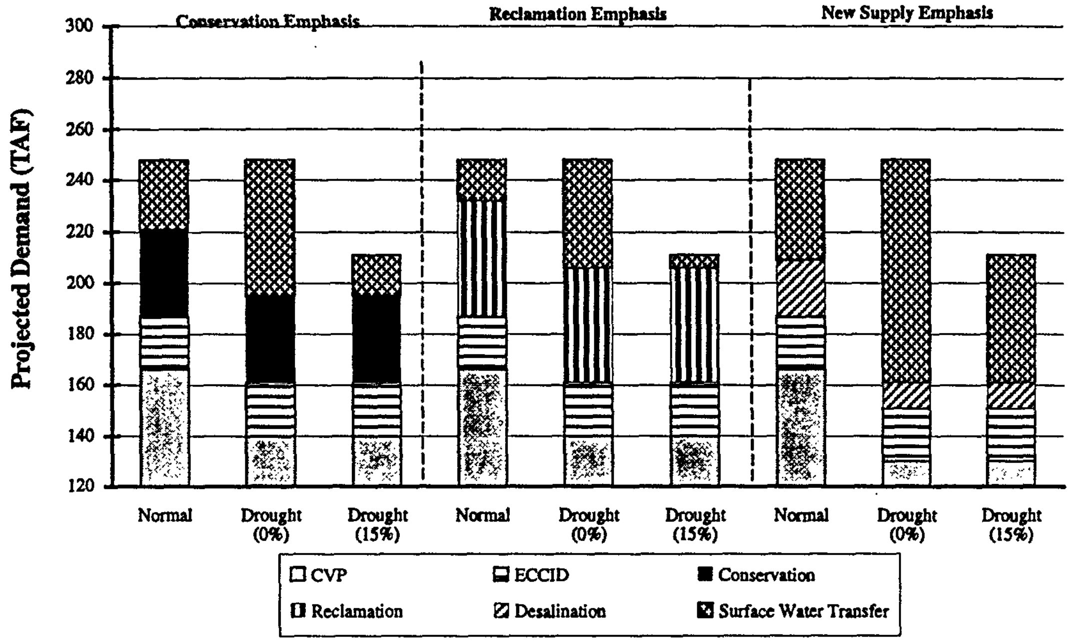
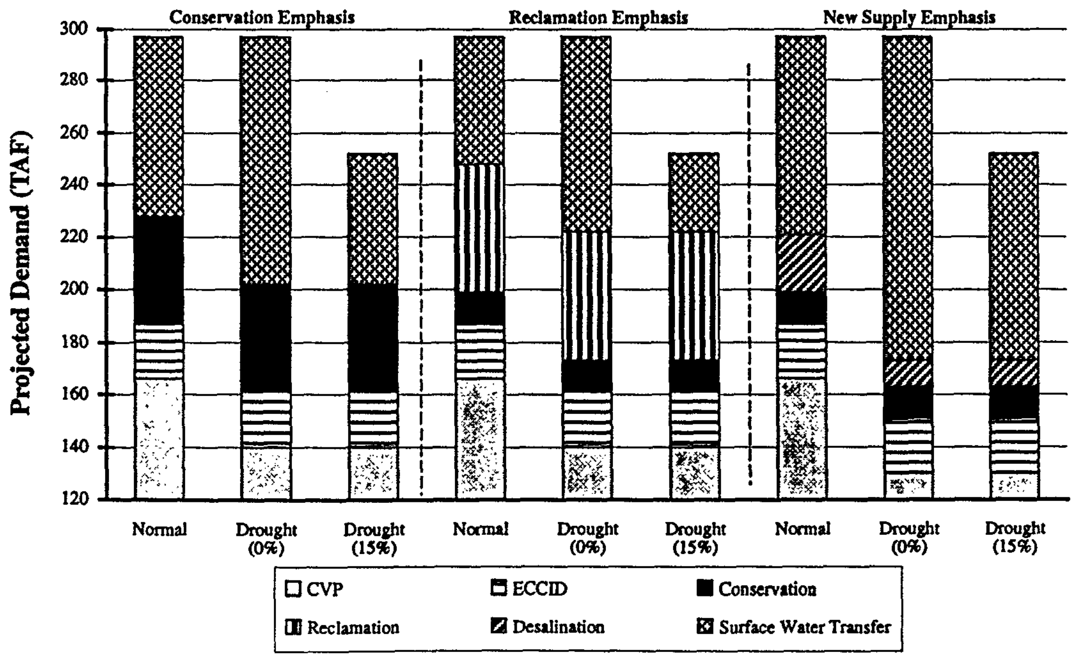


Exhibit 5-13
Resources for Supply Needs in the Year 2040
for Service Area F



Reclamation Emphasis. The Reclamation emphasis meets projected demand using the greatest quantity of recycled water feasible. Exhibit 5-14 shows the maximum feasible type of reclamation water for each of the three planning dates.

Exhibit 5-14
Maximum Reclamation Supply

Potential Category	2000	2020	2040
Agricultural Irrigation	0	0	6-10 TAF
Urban Irrigation	1 TAF	4 TAF	4 TAF
Industrial Use	12 TAF	35 TAF	35 TAF
Total	**13 TAF**	**39 TAF**	**45-49 TAF**

Potential categories for reclamation projects include Agricultural Irrigation, Urban Irrigation and Industrial Use. By the year 2000, the most promising components with potential to be built and implemented are Industrial Process Use (12 TAF) for use as cooling tower makeup only (Central County Industrial Use projects at Shell and Tosco), and the Central County Urban Irrigation project (1 TAF). These were selected based on numerous previous studies and the District's determination that these options could be quickly implemented. No other supplies are needed in the year 2000 due to the additional supplies gained from the expanded Service Area (i.e., the ECCID Transfer). No additional reclamation projects were perceived as feasible to implement within Service Areas E or F in the short term.

In the years 2020 and 2040, the Industrial Use was expanded by 13 TAF to include boiler feed water in Central County (Shell and Tosco), and by 10 TAF to include Pittsburg and Antioch Industrial Use (USS-Posco, Gaylord Container and Dow), for a total of 35 TAF. Central County Urban Irrigation (4 TAF) was also expanded from 1 TAF shown in the year 2000. East County Agricultural Irrigation (6 to 10 TAF) was added to Service Areas E and F in 2040 as an agricultural project that would expand recycling projects available to the East County. The Agriculture and Urban Irrigation reclamation projects in the East County are mutually exclusive. Although Urban Irrigation could be used, Agricultural Irrigation was chosen in the Reclamation emphasis due to its lower projected costs.

Surface water transfers were added in this emphasis to supplement reclamation supplies during drought years. In addition, because reclamation projects are not included in the contract calculation of historical use, less CVP water would actually be allocated in a drought, so that the need for additional supplies in a drought is only marginally reduced. Note that when demand exceeds CVP supplies, reclamation has no bearing on the drought supplies from the CVP, and becomes added, instead of substituted supply. The District will need to consider this factor when determining whether it is more effective to maximize existing CVP allocations, or implement a reclamation program. Exhibit 5-15 illustrates the method for calculating surface water transfers required in addition to recycled water projects.

Conservation Emphasis. As described in Chapter 4, the District developed three levels of conservation programs (Conservation Program Alternatives 1 through 3). CPA 3, the most aggressive program, was used in the initial evaluation to analyze a Resource Alternative focused on conservation. The impact of this program in the short term (i.e., the year 2000) was found to be minimal.

Exhibit 5-15
Reclamation Calculations

Year 2000 - Service Area C

Projected Demand: 176 TAF
- High End of Demand Envelope: 188 TAF
- Low End of Demand Envelope: 167 TAF

Reclamation Emphasis

- Industrial Process Use - (Shell/Tosco) Cooling Towers Only (12 TAF)
- Central County Urban Irrigation (1 TAF)

To Meet Demand of:	100%		85%	
Water Year Type	Normal	Drought	Drought	
Base Demand (TAF)	176	176	176	
Reclamation	-13	-13	-13	
	163	163	163	
Acceptance of Short-term Demand Management During Drought:			-26	(15% of 176)
			137	
Target Demand	163	163	137	
Supply				
CVP	163	122	122	(75% of 163)
Surface Water Transfer	0	41	15	
Totals	163	163	137	

Note: All figures in Thousand Acre-Feet (TAF).

Calculating net savings for any of the conservation programs requires subtracting those savings already assumed under the No Action program. The No Action program acknowledged the potential level of savings that should occur irrespective of District efforts (or those of its wholesale customers). Exhibit 5-16 shows the maximum long-term demand reduction levels.

Savings achieved through conservation are generally cost effective. Due to the District's amended CVP contract, conservation results in less CVP water allocated in times of shortages, resulting in a marginal reduction in the need for additional supplies. Note that when demand exceeds CVP supplies, conservation has no bearing on the drought supplies from the CVP and becomes added, instead of substituted supply. However, unlike reclamation projects, the costs of reducing the demand, in the long-term, are less than the District's cost of purchasing CVP water. One potential concern is the inherent uncertainty in predicting conservation savings - especially at extreme levels. Exhibit 5-17 illustrates the method for calculating surface water transfers required in addition to conservation projects.

Exhibit 5-16
Estimated Long-Term Conservation for CPA 3

Service Area	2000 *	2020	2040
C	5 TAF	27 TAF	29 TAF
E	6 TAF	31 TAF	34 TAF
F	6 TAF	35 TAF	41 TAF

* Assumes full recovery from 1991 drought reductions.

Exhibit 5-17
Conservation Calculations

Year 2000 - Service Area C

Projected Demand: 176 TAF
- High End of Demand Envelope: 188 TAF
- Low End of Demand Envelope: 167 TAF

Conservation Emphasis

- Conservation Program 3 (5 TAF)
(5% Program 3 - 2% (No Action) = 3% conservation

To Meet Demand of:	100%		85%	
Water Year Type	Normal	Drought	Drought	
Base Demand (TAF)	176	176	176	
Conservation	-5	-5	-5	(3% of 176)
	171	171	171	
Acceptance of Short-term Demand Management During Drought:			-26	(15% of 171)
Target Demand	171	171	145	
Supply				
CVP	171	128	128	(75% of 171)
Surface Water Transfer	0	43	17	
Totals	171	171	145	(85% of 171)

Note: All figures in Thousand Acre-Feet (TAF).

5-18

Grouping of the Resource Alternatives for Round 1 Evaluation

The evaluation process was simplified by recognizing similarities in the Resource Alternatives developed to solve for the nine possible normal year demand scenarios (resulting from the combinations of the three service areas and the three target planning dates). Although there were nine separate demand scenarios for which potential Resource Alternatives were developed in Round 1, it was determined unnecessary to evaluate each separately. The far right column shown in the earlier Exhibit 5-1 reflects the minimal difference in additional supply required among some demand scenarios. Many of the supply components developed for Service Area C were found to be similar to those developed for Service Areas E and F, due to the addition of the ECCID transfer water in those service areas and the resulting lack of need for additional significant supplies. For this reason, it was determined that the evaluations could be combined into the five groups shown below, which have similar quantities of required supplies in addition to CVP supply and ECCID transfer water.

The District evaluated five groups of Resource Alternatives, referred to as demand scenarios:

Service Area C, E and F	Year 2000
Service Area C and E	Year 2020
Service Area F	Year 2020
Service Area C and E	Year 2040
Service Area F	Year 2040

As part of the Round 1 evaluation process, the District rated the three Resource Alternative strategies against the screening criteria, focusing on these five demand scenarios.

Evaluation of the Round 1 Resource Alternatives

As part of Round 1, the District compared the preliminary per unit water costs for each of the resources emphasized. A more detailed evaluation using the economic criteria is included in the Round 2 evaluation. The detailed evaluations are presented in Exhibits 5-18 through 5-21. These five exhibits display the evaluations for the five groups of Resource Alternatives, showing the ratings for the New Supply emphasis, the Reclamation emphasis and the Conservation emphasis under each of the twelve criteria presented in Exhibit 5-2. As discussed earlier, the evaluations were simplified by reducing the nine possible demand scenarios to five which had similar quantities of required supplies in addition to CVP supply and ECCID transfer water. A summary of how each resource emphasis scored relative to the criteria in the short and long term is presented below.

Operational Criteria. Scores for O1 (minimize shortages) remained high as shortages were assumed to be met with water transfers in the short and long term under each of the three strategies. The New Supply and Conservation emphases scored high for O2 (reliability) in the short-term; the Reclamation emphasis scored slightly lower, due to the potential challenges in maintaining technical reliability. In the longer term and for Service Area F in 2020 and 2040, the New Supply emphasis scored much lower (M-) due to the increased complexity of the brine treatment and disposal associated with desalination. The water quality criterion (O3) established no real distinguishing factors among the Resource Alternatives. The Conservation emphases scored high throughout; the Reclamation Emphases scored slightly lower (H-) throughout due to new technology; and the New Supply Emphases scored higher in the short term (H) with scores dropping in the long term, especially for Service Area F, due primarily to concerns of achieving proper water quality through desalination.

Economic Criteria. The economic evaluation in Round 1 was cursory, focusing on preliminary unit costs only. Costs associated with reclamation projects are higher than water transfers. Transfer costs for the New Supply emphasis were examined for annual transfers based on existing market prices available, and the additional cost of annual storage. Supply options involving water transfers in the year 2040 were difficult to

Exhibit 5-18
Application of Evaluation Criteria

Service Areas C/E/F - Year 2000

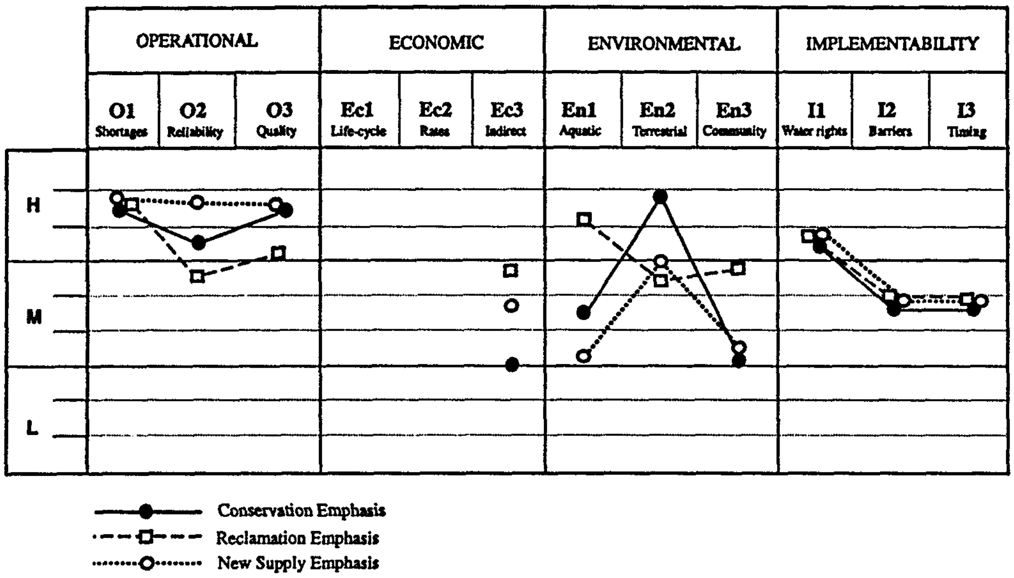


Exhibit 5-19
Application of Evaluation Criteria

Service Areas C/E - Year 2020

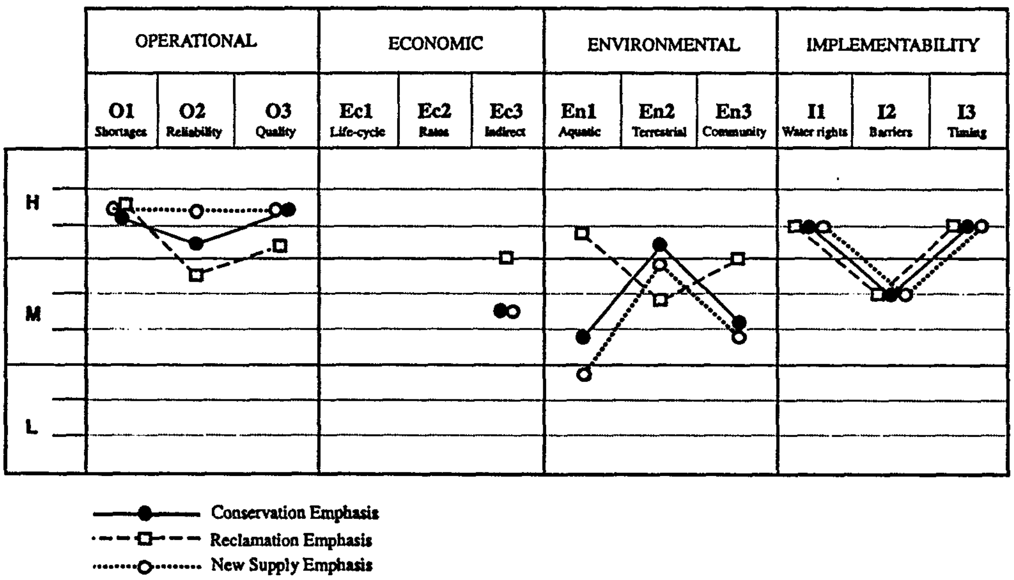


Exhibit 5-20
Application of Evaluation Criteria

Service Area F - Year 2020

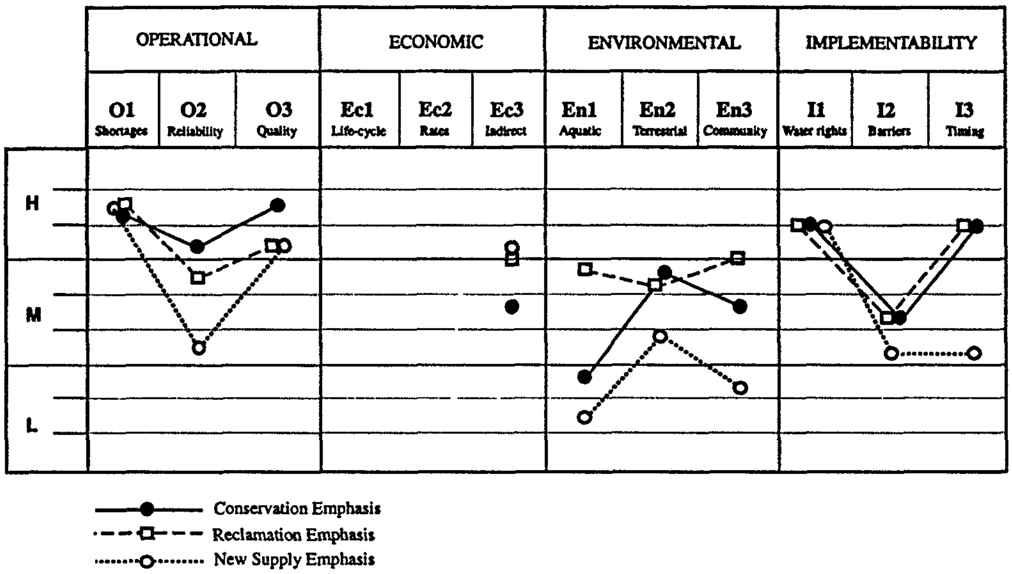


Exhibit 5-21
Application of Evaluation Criteria

Service Areas C/E - Year 2040

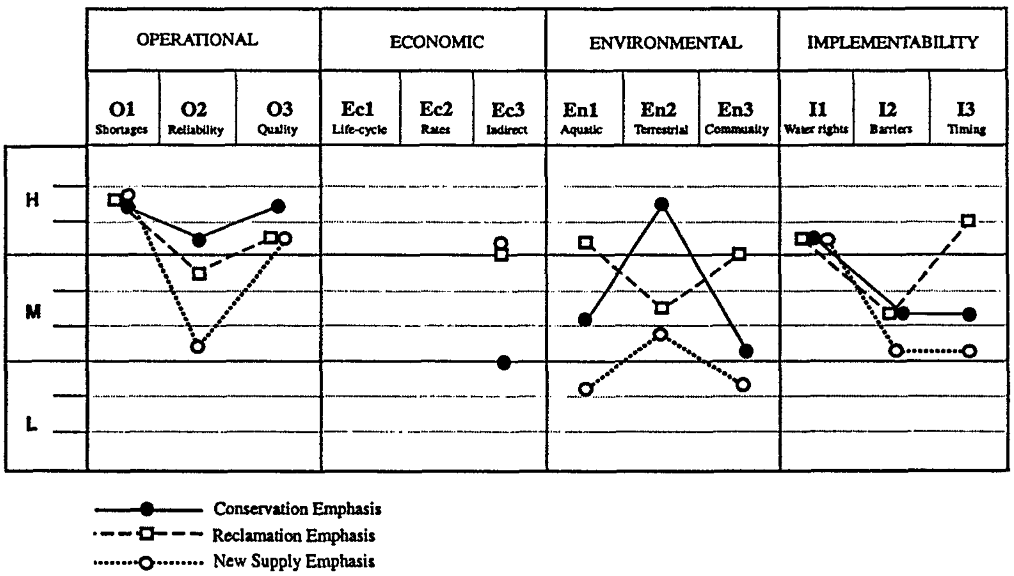
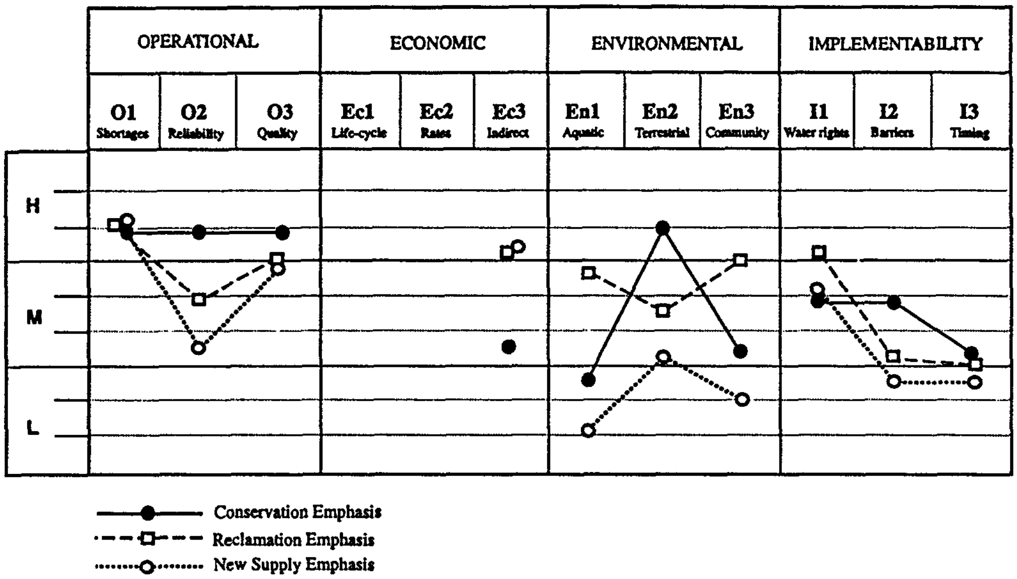


Exhibit 5-22
Application of Evaluation Criteria

Service Area F - Year 2040



5-22 accurately estimate due to the overall dynamics of supply and demand for California water and the resulting effects on cost. Preliminary evaluation of cost shows that the longer the planning horizon, the more economical the cost of water. The more detailed economic evaluation was reserved for Round 2, once more balanced Resource Alternatives were developed by integrating the most promising components.

The indirect economic criterion (Ec3) rated reclamation higher (H-) throughout based on the expected increase in jobs for construction and operation of facilities. New supply was expected to have minimal beneficial or negative impacts and rated (M) in the short term and higher in the long term (H-) for Service Area F in 2020 and 2040 due to the potential jobs which could be created through construction and operation of a desalination plant. CPA 3 was evaluated lower (M to M-) throughout based on the expected impact such a program would have on the landscaping industry.

Environmental Criteria. The scores for the aquatics criterion (En1) were primarily based on the amount of water withdrawn from the Delta. Due to surface water transfers required under all Resource Alternatives, some scores were not self evident. The Reclamation emphasis scored the highest throughout (H/M+ range) because it would be a permanent offset of Delta withdrawal and generally would require the least amount of additional water transfers. The Conservation emphasis would also have a beneficial impact; however, surface water transfers required to supplement conservation brought the score to a M-/L+ range. In general, the New Supply emphasis scored poorly (M-/L range) compared to the others due to increased withdrawals from the Delta and the effects of maximizing diversions at Mallard Slough for desalination.

Conservation and reclamation would have beneficial impacts relative to the terrestrial criterion (En2). The New Supply emphasis, specifically the desalination component, brought scores down due to the effects of higher withdrawals from the Delta and the San Joaquin River. In evaluation of community impacts, the Reclamation emphasis was expected to benefit the community (En3) due to increased jobs and the reuse of resources, rating in the M+/H- range throughout. Conservation (especially CPA 3) was perceived to influence lifestyle changes and perhaps impact jobs thus scoring lower (M/M- range) for the short and long term. New Supply scored M- to L for the short to long term based on the potential of increased water exports out of other communities, potential for fallowing agricultural land as a means of obtaining supply, and the high energy use associated with desalination.

Implementability Criteria. With one exception, all demand scenarios yielded High scores for the water rights criterion (I1). The exception was Service Area F in the year 2040, where scores for New Supply and Conservation dropped slightly due to the magnitude of the savings and transfers. The three Resource Alternatives scored similarly under the institutional barriers (I2) criterion. New Supply scored slightly lower due to the greater quantities of water transfers and the addition of desalination in the long term in Service Area F in 2020 and 2040. Because water transfers are a part of each resource emphasis, there is a potential for delay with both Reclamation and Conservation. Reclamation and New Supply scored lowest (M- and L+) in Service Area F in 2040, due to the large amount of transfers and increased expansion of reclamation projects into the East County.

Timing (I3) was evaluated assuming that all components could be achieved with possible delay. All alternatives scored medium (M) in the year 2000 based on the District's confidence that each could be implemented within the next five years. Scores diverged for 2020 in Service Area F due to the increased lead time for planning and implementation necessary for water transfers. New Supply scored lower (M-) when desalination was included as a component due to permitting requirements. All Resource Alternatives scored relatively low in Service Area F - Year 2040 based on the degree of projects and transfers required to meet increased demand for that service area in the long term. The inclusion of CPA 3 within the Resource Alternative emphasizing Conservation had little impact on evaluations in the earlier years due to confidence in implementation and the small quantities of water involved. Scores were brought down slightly (M) for the year 2040, as the quantities projected for conservation savings are maximized and necessary water transfers increase.

Conclusions - Determining the Most Promising Components

The goal of Round 1 was to identify the most promising components, which could then be combined to form improved, more balanced Resource Alternatives during Round 2. Based on the Round 1 evaluation, the most promising components for integration into the Round 2 Resource Alternatives were CVP water, surface water transfers, groundwater export, conservation and reclamation; desalination was not carried forward into Round 2.

CVP Water. CVP supplies are the single-most important component. CVP supplies are capable of meeting the majority of demand for all three Service Areas in the year 2040. The CVPIA could reduce the District's entitlement by 15% by the year 2010, or as early as the year 2000. This could reduce future CVP supplies to 166 TAF per year during a normal year, rather than the current contract amount of 195 TAF per year.

Surface Water Transfers/Groundwater Export. The screening of transfers is discussed in further detail in Chapter 6.

Conservation. The conservation programs establish a framework for evaluating a range of potential water savings options. Conservation serves as a valuable component by reducing future water demand. It is assumed that at least a minimum level of conservation (CPA 1) will be included in the Recommended Preferred Alternative; all of the Resource Alternatives tested in Round 2, therefore, integrate some level of conservation. Conservation has the maximum benefit over the long term.

Reclamation. Reclamation was included as a building block to help meet short- and long-term future needs. Specific projects, such as urban irrigation projects for landscaping, were viewed as potential ways to help meet demand as soon as the year 2000. The CCCSD has embarked on a Central County urban irrigation program estimated at supplying approximately 1 TAF, which is included in the targets for achieving urban irrigation within the Central County. Three levels of reclamation were advanced to Round 2 for testing.

The minimum level would combine urban irrigation projects in the Central County and Antioch to achieve a total of approximately 5 TAF by the year 2020. The intermediate level would combine the Central County urban irrigation project with recycled water for use in cooling towers (100%) at Shell and Tosco to achieve a total of approximately 17 TAF by the year 2020. The maximum level would combine recycled water for Shell and Tosco boiler feed with the above project to achieve a total of approximately 30 TAF by the year 2020. Service Areas E and F would include 5 TAF of additional recycled water for use in agricultural irrigation projects in the East County. These projects were selected based on the District's expectations for expediency in implementation, and will be developed in phases. The timing of projects is discussed in Chapter 7.

Desalination. Desalination was not included in any of the Round 2 Resource Alternatives. This component could benefit the District through maximizing use of an existing water right and assisting the District in meeting customer demand during a dry year. However, it was concluded that high energy costs, brine disposal issues and high construction costs brought scores down for Resource Alternatives in Round 1 that included this component. Permanent desalination was found to be a rather inflexible solution financially, and the large capital costs could preclude other solutions. Although desalination will not be considered for further study at this time, it is suggested this component be revisited in future updates of the Future Water Supply Study (every 5 years or so) to review how technology may have progressed to reduce construction and operating costs. Desalination could still be considered during a drought emergency by bringing reverse osmosis trailers to a site for delivery of water if a transfer is not available.

Key Criteria

In addition to identifying the most promising supply and conservation components to carry forward into the Round 2 analysis, the Round 1 evaluation revealed that certain criteria best distinguish the various Resource Alternatives. That is, although all 12 criteria (as listed in Exhibit 5-2) are considered important, it was found that five key criteria best distinguished the benefits of the Resource Alternatives:

- O1: Minimize water shortages in frequency and magnitude,
- O2: Maximize water reliability,
- Ec1: Minimize life-cycle costs,
- Ec2: Minimize rate impacts to customers, and
- I3: Ensure proper timing and phasing.

SUMMARY AND CONCLUSIONS

The following is a summary of the findings from the Round 1 analysis. These finding were carried forward into Round 2 of developing Resource Alternatives.

- Based on the initial evaluation of the Resource Alternatives, the most promising components, in addition to the CVP water, include.
  - Conservation
  - Surface Water Transfers/Groundwater Export
  - Reclamation
- Desalination, to maximize the District's existing Mallard Slough water right, was tested in the New Supply emphasis and appears to have only marginal benefits. The benefit of desalination was outweighed by the high energy costs, high construction costs, brine disposal and lack of flexibility as shown in Exhibit 5-20 through 5-22.
- Conservation has the maximum benefit over the long-term. Therefore, all Resource Alternatives should use some level of conservation.
- No matter what additional conservation and/or reclamation programs are implemented, in the short term the District will still require a water transfer of between 15 to 44 TAF during a dry year as shown in Exhibit 5-5. The District's options are:
  - Purchase transfers only in dry years, thereby lessening reliability.
  - Purchase transfers and bank them every year, thereby increasing both reliability and cost.
  - Purchase options to be exercised in drought years.
- Near term comparison demonstrated that each emphasis provides generally the same results in terms of the surface water transfers required during a dry year. Conservation or reclamation could reduce the need for a surface water transfer. Reclamation has a potentially greater influence to offset demand due to the number and variety of potential projects.
- Under the New Supply emphasis, the need for surface water transfers approaches 50 TAF during a normal year, and much higher during a drought year. At those levels, the need for storage becomes critical.
- Conservation and reclamation have a much more beneficial impact on supply in the long term (i.e., the year 2040) as shown in Exhibits 5-12 and 5-13. However, a water transfer would still be required to meet drought year demand.
- The criteria that best distinguish between the Round 1 Resource Alternatives are O1, O2, Ec1, Ec2, and I3.

As mentioned above, despite maximizing the components within the reclamation and conservation resource categories, a significant water transfer component is needed in those options. Technical Appendix D presents a detailed analysis of specific pathways, streamflow changes, and the optimization of operational needs for potential transfers. Negotiations, permitting and the approval process for transfers is discussed in further detail in Chapters 6 and 7.

Based on these conclusions, the District advanced the most promising resource components to develop the Round 2 Resource Alternatives, as described in Chapter 6.

6. Screening of the Resource Alternatives and Selection of the Preferred Alternative

OVERVIEW

During the Round 1 screening, the District identified less viable components, which were held from further study and suggested for consideration during future review of the FWSS. The most promising components from Round 1 were retained and combined to develop the Round 2 Resource Alternatives, all of which rated fairly well against the key criteria. The goal of Round 2 was to evaluate the Alternatives with an emphasis on life-cycle costs, while also considering the reliability and implementability criteria. Round 2 involved two stages of screening: (1) a preliminary screening of all six Resource Alternatives initially developed, and (2) a more detailed evaluation of the three most promising Alternatives, based on the preliminary Round 2 screening.

This chapter summarizes the results of the Round 2 screening process, and subsequent analysis of the three final Resource Alternatives. This final analysis identifies the components of Resource Alternatives 1, 2 and 3; presents their present worth costs and future rate impacts; screens and ranks them against the key criteria; and identifies the Recommended Preferred Alternative.

DESCRIPTION OF THE ROUND 2 RESOURCE ALTERNATIVES

During Round 2, the District developed, analyzed and screened six Resource Alternatives. The six Resource Alternatives integrated larger levels of conservation and reclamation as the alternatives move from 1 to 6. The goal of the Round 2 process was to evaluate Resource Alternatives comprised of the most promising components from Round 1 while continuing to integrate flexibility into the development of future supplies.

As in Round 1, the Round 2 Resource Alternatives solve for average demand. In the short term (i.e., the year 2000), solving for the high or low end of the demand envelope would have a minimal effect on surface water transfers required. In the long term, however, a sizable difference may occur when water demands are larger and the size of the envelope increases to its maximum size (+15/-10%). But given the 50-year planning horizon and the similarities between solving for drought year demand and solving for the high end of the demand envelope (both are influenced by weather and water year type), solving for average demand was deemed the most reliable indicator for the long term. In addition, it was determined that Round 2 Resource Alternatives should focus on the year 2020, with the District developing implementation strategies focused on 5- to 10-year increments for the phasing of projects.

The six Resource Alternatives are described below and illustrated in Exhibit 6-1.

Resource Alternative 1

Resource Alternative 1 relies on a minimal level of conservation and includes no reclamation projects. Primary reliance is on the purchase of surface water transfers (38 TAF

Exhibit 6-1
Resource Alternatives - Round 2

Year 2020
(with Assumed CVPIA Reductions of 15%)

Service Area Alternatives	ALTERNATIVES 1	ALTERNATIVES 2	ALTERNATIVES 3
C 210 TAF	**Drought/Normal** • CVP[1] (140/166 TAF) • *[CPA 1 (6 / 6 TAF)]* • Surface Water Transfers/Rights (33-64 / 38 TAF)	**Drought/Normal** • CVP (140/166 TAF) • *[CPA 2 (13 / 13 TAF)]* • Surface Water Transfers/Rights (26-57 / 31 TAF)	**Drought/Normal** • CVP (140/166 TAF) • *[CPA 2 (13 / 13 TAF)]* • Reclamation (5 / 5 TAF) • Surface Water Transfers/Rights (21-52 / 26 TAF)
E 237 TAF	• CVP (140/166 TAF) • *[CPA 1 (7 / 7 TAF)]* • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (33-69 / 43 TAF	• CVP (140/166 TAF) • *[CPA 2 (14 / 14 TAF)]* • ECCID Transfer (21 / 21 TAF) • SurfaceWater Transfers/Rights (26-62 / 36 TAF)	• CVP (140/166 TAF) • *[CPA 2 (14 / 14 TAF)]* • Reclamation (10 / 10 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (16-52 / 26 TAF)
F 273 TAF	• CVP (140/166 TAF) • *[CPA 1 (8 / 8 TAF)]* • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (63-104 / 78 TAF) • Banking	• CVP (140/166 TAF) • *[CPA 2 (16 / 16 TAF)]* • ECCID Transfers (21 / 21 TAF) • Surface Water Transfer/Banking (55-96 / 70 TAF) • Banking	• CVP (140/166 TAF) • *[CPA 2 (16 / 16 TAF)]* • Reclamation (10 / 10 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (45-86 /60 TAF) • Banking

1. "CVP supplies" referred to in a normal year encompass CVP supplies and other supplies if available, but the District must be prepared to meet the full amount in any year.

Exhibit 6-1 (Continued)
Resource Alternatives - Round 2

Year 2020
(with Assumed CVPIA Reductions of 15%)

Service Area Alternatives	ALTERNATIVES 4	5	6
C 210 TAF	**Drought/Normal** • CVP (140/166 TAF) • *[CPA 2 (13 / 13 TAF)]* • Reclamation (30 / 30 TAF) • Surface Water Transfers/Rights (0-27 / 1 TAF)	**Drought/Normal** • CVP (140/166 TAF) • *[CPA 3 (27 / 27 TAF)]* • Surface Water Transfers/Rights (12-43 / 17 TAF)	**Drought/Normal** • CVP (140/166 TAF) • *[CPA 3 (27 / 27 TAF)]* • Reclamation (17 / 17 TAF) • Surface Water Transfers/Rights (0-26 / 0 TAF)
E 237 TAF	• CVP (140/166 TAF) • *[CPA 2 (14 / 14 TAF)]* • Reclamation (35 / 35 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (0-27 / 1 TAF)	• CVP (140/166 TAF) • *[CPA 3 (31 / 31 TAF)]* • ECCID Transfer (21 / 21 TAF) • SurfaceWater Transfers/Rights (9-45 / 19 TAF)	• CVP (140/166 TAF) • *[CPA 3 (31 / 31 TAF)]* • Reclamation (22 / 22 TAF) • ECCID Transfer (21 / 21 TAF) • SurfaceWater Transfers/Rights (0-23 / 0 TAF)
F 273 TAF	• CVP (140/166 TAF) • *[CPA 2 (16 / 16 TAF)]* • Reclamation (35 / 35 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfers/Rights (20-61 /35 TAF) • Banking	• CVP (140/166 TAF) • *[CPA 3 (35 / 35 TAF)]* • ECCID Transfer (21 / 21 TAF) • Surface Water Transfer/Banking (36-77 / 51 TAF) • Banking	• CVP (140/166 TAF) • *[CPA 3 (35 / 35 TAF)]* • Reclamation (22 / 22 TAF) • ECCID Transfer (21 / 21 TAF) • Surface Water Transfer/Banking (14-55 /29 TAF) • Banking

in a normal year for Service Area C) to supplement the reduced CVP allocation which would occur by 2010. This combination of components is expected to be very flexible and relatively easy to implement, since no new technology or construction of facilities would be required. Costs for this Resource Alternative are expected to be relatively low. Spot transfers would be used to meet demand during a drought. Since 78 TAF of transfer water would be required in Service Area F in a normal year, water banking was included as a component for that Service Area.

Resource Alternative 2

Resource Alternative 2 is very similar to Resource Alternative 1 but includes an intermediate level of conservation (CPA 2), thereby requiring less surface water transfers (31 TAF in a normal year for Service Area C) to meet projected demand. The difference in demand offset through the use of conservation between Resource Alternatives 1 and 2 is only 7 to 8 TAF. This combination is again expected to be very flexible, easy to implement and relatively low in cost. Spot transfers would supplement supply during a drought. Banking was included for Service Area F only.

Resource Alternative 3

Resource Alternative 3 maintains an intermediate level of conservation (CPA 2) and introduces a low level of reclamation. The anticipated reclamation projects would combine urban irrigation projects in the Central County and Antioch to achieve 5 TAF for Service Area C. The addition of an agricultural irrigation reclamation project in East County for Service Areas E and F would achieve an additional 5 TAF by the year 2020.

Surface water transfers required would therefore be less than those for the previous two Resource Alternatives, with approximately 26 TAF required for Service Areas C and E. Spot transfers would be used to supplement drought supplies. Banking was included for Service Area F only. This combination of components is again expected to be flexible but somewhat higher in cost due to the addition of the reclamation projects. Based on numerous previous studies addressing urban irrigation in Central County, this Resource Alternative is expected to be very implementable.

Resource Alternative 4

Resource Alternative 4 includes the same intermediate level of conservation as Resource Alternatives 2 and 3, but includes the highest level of reclamation of all the Resource Alternatives. The anticipated reclamation projects would include Shell and Tosco cooling towers and boiler feed water, in addition to urban irrigation projects, for a total of 30 TAF by the year 2020.

Agricultural irrigation projects in the East County were added for Service Areas E and F. Projects were selected based on expediency in implementation. Surface water transfers, as a result, are further reduced to almost zero during a normal year in Service Areas C and E, and down to 35 TAF in Service Area F. Spot transfers would be used to supplement drought supplies. Banking was included as a component for Service Area F only, based on the quantity of water required during a drought year.

This combination of components is expected to be lower in flexibility, higher in cost due to the addition of greater levels of reclamation, and somewhat lower in technical reliability due to the new technology associated with more stringent levels of treatment.

Based on previous studies addressing reclamation projects in the District, this Resource Alternative is expected to be very implementable.

Resource Alternative 5

Resource Alternative 5 combines the highest level of conservation (CPA 3) with surface water transfers. Transfers for Service Areas C and E would range from 17 to 19 TAF in a normal year, and increase to 51 TAF in Service Area F. Spot transfers would be used to supplement drought supplies. A banking component has been included only for Service Area F.

This combination of components is expected to be very flexible but difficult to implement, and not very reliable due to the high conservation levels. Costs for this Resource Alternative are expected to be potentially the lowest of the six.

Resource Alternative 6

Resource Alternative 6 was initially created to maximize both conservation and reclamation components. This combination would actually provide surplus water; although this was a potentially valid solution for the year 2040, developing this supply level (and the subsequent need to store the surplus at this point in time) would force projects to be phased in too early, potentially creating unnecessarily high costs. This Resource Alternative was modified to integrate the highest level of conservation (CPA 3) with an intermediate level of reclamation (17 to 22 TAF). During a drought year, this combination would limit transfers to between 23 to 26 TAF for Service Areas C and E and would eliminate the need for a transfer in a normal year. Service Area F would still require a water transfer of 29 TAF during a normal year, and between 14 to 55 TAF in a drought year, therefore banking was included.

Reliability is relatively low for Resource Alternative 6 based on the expected difficulty of maintaining CPA 3 and the complexity of the reclamation projects; flexibility based on the variety of components is good. Resource Alternative 6 would be difficult to implement, however, due to the high level of conservation, particularly with wholesale customers. Costs are expected to be moderate to high.

ROUND 2 EVALUATION

The approach for Round 2 was to evaluate the Resource Alternatives with an emphasis on life-cycle costs, while also considering the reliability and implementability criteria. Combined costs were projected for the Alternatives by considering the implementation schedules for those components included within each. The team focused cost projections on Service Area C, with incremental costs for Service Areas E and F examined in less detail. The final criterion (Ec2 - Rates) was applied to the three most viable Resource Alternatives from the Round 2 evaluation as part of identifying the Recommended Preferred Alternative, and is further discussed later in this Chapter.

The team focused on Service Area C for two primary reasons. First, this Service Area encompasses the District's existing Service Area and the planning area of existing customers. At this point in time, the District can only make decisions based on demand within that area. Although the District does not intend to preclude future decision-making that might occur in the East County, it would be premature to identify a Recommended Preferred Alternative based on an expanded service area. Instead, the identification of the Recommended Preferred Alternative was based on Service Area C, using the incremental costs of providing water to Service Areas E and F as a basis for rate analysis and the development of implementation schedules. This approach, however, allows flexibility for decisions on future expansion of the District's system.

Second, the mix of components within Service Areas C, E and F differs by quantity, but not in the combination of components. Although the ranking of Resource Alternatives may differ in magnitude among the Service Areas, the relative ranking between Resource Alternatives remains the same, allowing the team to narrow its focus to Service Area C.

The key components of each Alternative (e.g., transfers, reclamation and conservation) were evaluated on the basis of the key criteria (reliability, implementability and cost). Results of the Round 2 analysis are summarized below.

Evaluation of Reliability

Resource Alternatives were evaluated and ranked based on their technical reliability. Technical reliability refers to the reliability of infrastructure and facilities, such as pumps, pipelines, reverse osmosis treatment, and ULF toilets. This category was used to rate the components in terms of facilities, operations and the ability to achieve the desired supply, including during a drought. Drought reliability was also considered later, primarily in the examination of flexibility and feasibility of the three conservation programs.

5-6 With respect to operations, transfers are the most technically reliable because they are compatible with the District's existing facilities, operations and infrastructure. Once water is pumped from the Delta, no additional facilities are required for delivery. Transfers also offer the most reliability because they can be tailored to the District's seasonal needs.

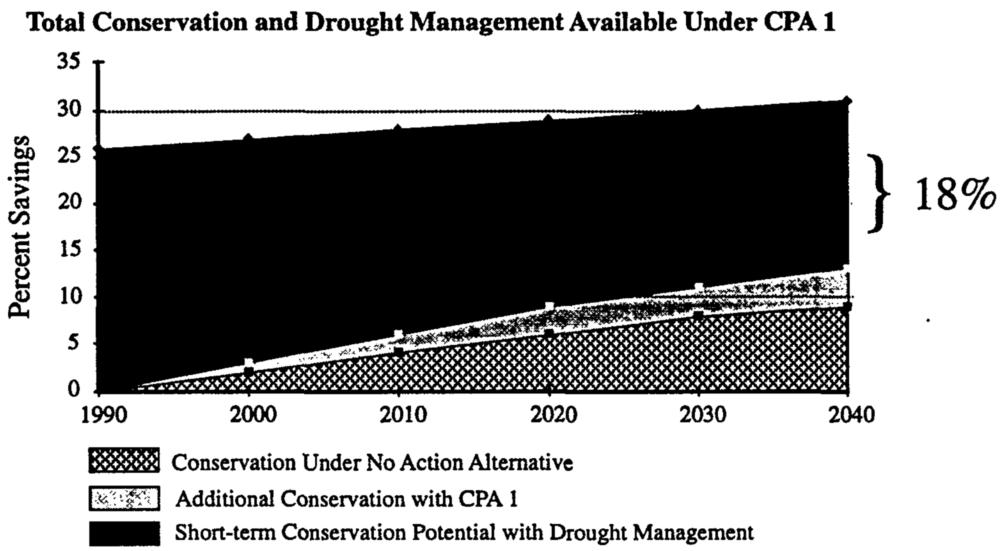
Reclamation is considered technically less reliable today because it is more prone to facility complexities; however, technology should improve in the future. During the Round 2 evaluation, components with lower quantities of reclamation and those requiring less treatment rated higher. Reclamation components, although reliable, have a greater degree of potential for technological complications than other components (e.g., transfers), and therefore rated lower.

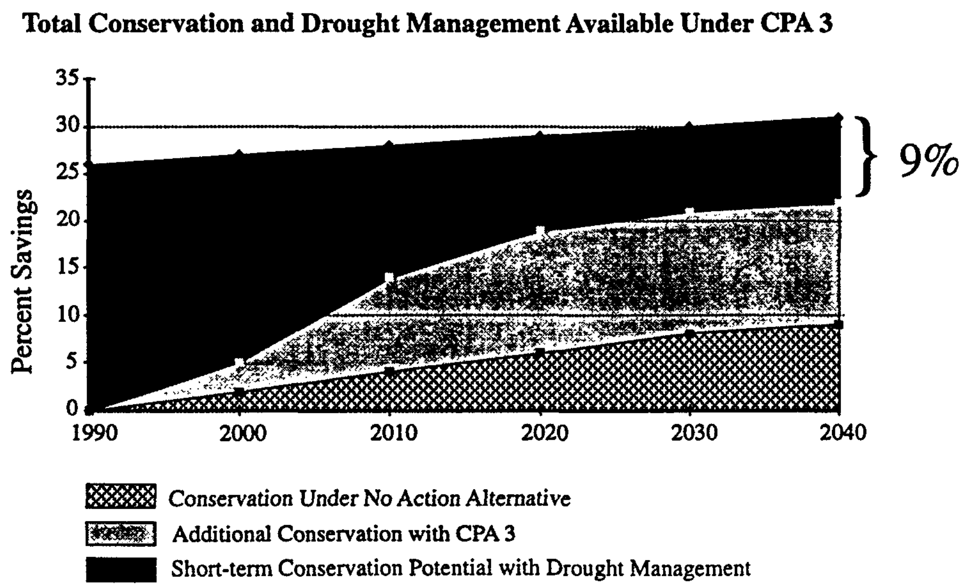
Conservation is considered technically reliable; however, problems of customer acceptance and retention decrease reliability at more aggressive levels. Water savings projected due to such measures as fixtures (ULF toilets, for example) are reliable for future planning due to the legislative requirements within new homes. However, the current availability of standard fixtures and household appliances creates an opportunity for customers to return to conventional fixtures, thus affecting technical reliability. Also, relying too heavily on conservation shifts the responsibility of meeting demand to the customer, thereby making it less reliable.

Reliability during drought periods, or the impact on various components during dry years, is another consideration. Reclamation, for example, has strong appeal during a drought due to the relative consistency of source water, though technical reliability is lower due to the heavy reliance on facilities and equipment and the newer technology. Surface water transfers have a high degree of technical reliability since existing facilities will be used, and a lower degree of drought reliability due to the increased pressure on supplies. Transfers were assumed to be obtainable by the District through a spot transfer during a drought, acknowledging the higher cost. An alternative would be to enter into a long-term contract or purchase of a water right for a quantity greater than required during a normal year, which would allow the District a margin for cut-backs during a drought year. Additional water not required during normal or wet years could be sold and/or used as mitigation credits for the environment.

Conservation is the component most potentially affected during drought due to the relationship of results achieved versus drought management measures the District can implement during dry years. Conservation hardens demand at higher levels, which reduces the customers' ability to respond to requests to decrease water use in a dry year

Exhibit 6-2
Effect of Conservation on Potential Drought Management Response





when District supplies are reduced. Exhibit 6-2 illustrates this point by comparing the estimated effects of CPA 1 to that of CPA 3. The use of higher conservation levels would make drought management unreliable as a means to offset supply shortfalls. It was assumed in the exhibit that increasing use of new technology would increase overall savings from 26% (achieved within the TWSA in 1991) to 31% in 2040. CPA 1 would reduce effectiveness of drought management from 26% in 1990 to 18% in 2040. The potential for drought management under CPA 3 would change from 26% in 1990 to 11% by 2020, and 9% by 2040. Such a combination would, therefore, sharply curtail the District's ability to respond to a drought solely through the short-term reduction of demand. A lengthy drought would affect the District's reliability for maintaining the levels of savings associated with CPA 3. Demand hardening is discussed in further detail in Technical Appendix C.

Based on this assessment of reliability, Resource Alternatives 1 and 2 rated High due to their emphasis on the use of transfers. Resource Alternative 3 rated slightly lower due to the reduced levels of transfers and the introduction of reclamation. Resource Alternatives 4, 5 and 6 rated Low on reliability due to the combination of high levels of reclamation and conservation, and the potential impact of demand hardening in Resource Alternatives 5 and 6. Ratings are summarized in Exhibit 6-3.

Exhibit 6-3
Evaluation of Reliability

Alternative	1	2	3	4	5	6
Rating:	HIGH	HIGH	MOD.	LOW	LOW	LOW

Evaluation of Implementability

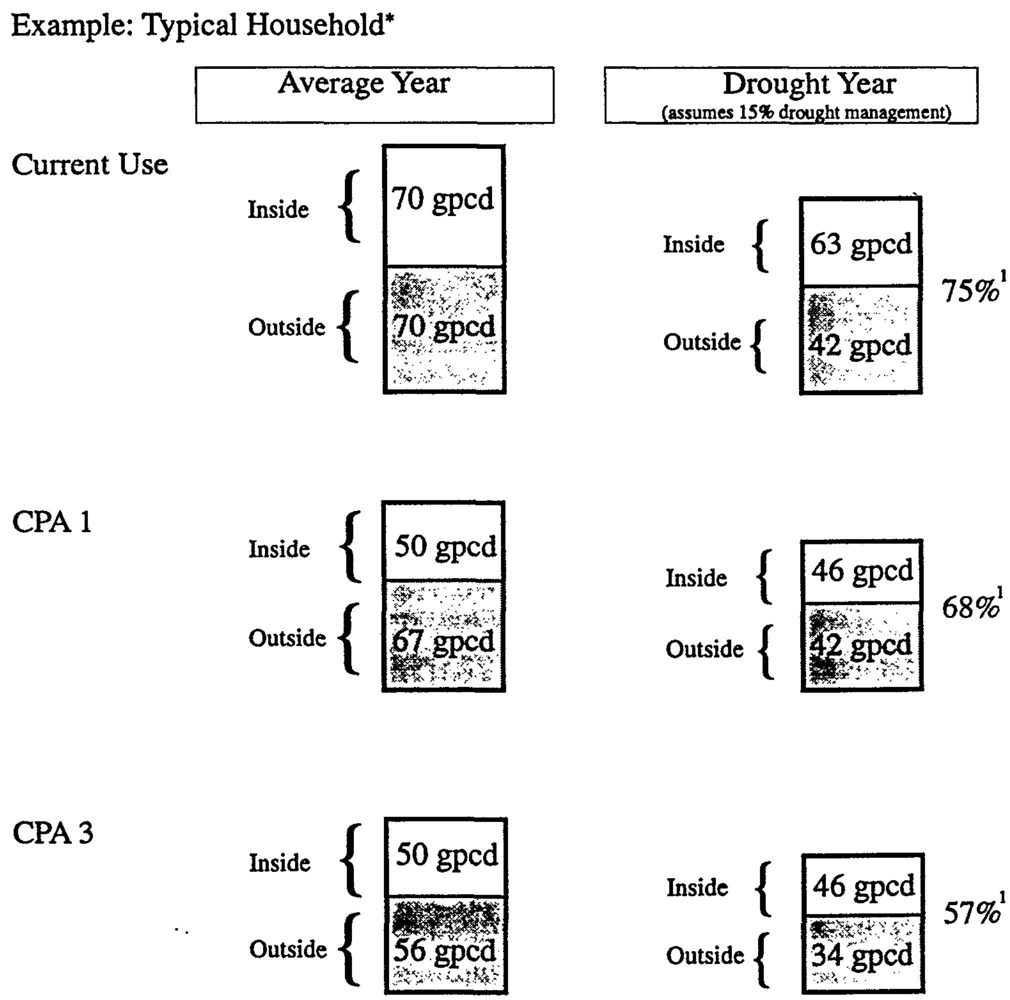
Implementability was used to evaluate the Resource Alternatives based on the complexity of implementing and permitting, as well as a project's institutional requirements. Factors examined include the number of approvals required, the permitting process, construction and environmental constraints, agency interaction, contracting and negotiations, and expected length of the planning process. The more complex and the larger the number of agencies and approvals required, the lower the implementability score. Agencies within the District and local contracts were viewed more favorably. State and Federal contracts can increase complexity and implementation time. For these reasons, in reviewing this criterion, water transfers were perceived as the most complex component to develop based on the complexity of negotiations and the number of agency approvals required. Resource Alternatives that incorporate higher levels of transfers scored lower for this criterion.

Due to the number of previous feasibility studies prepared and the targeted selection of reclamation projects requiring minimal implementation hurdles for inclusion in the Alternatives development, Resource Alternative 4 rated well for implementability. Reclamation would require contracting with treatment agencies and users; however, most would be local agencies with which the District has existing contracts. The increased levels of treatment required could be more difficult to implement; however, the increased technology in recent years has made construction of recycling projects more common. Reclamation and conservation would free up existing potable supplies, allowing the District to extend the use of their existing water entitlement. Resource Alternative 4 rated high on implementability based on the inclusion of moderate conservation, local reclamation projects that would not be phased in for the most part until the years 2011 and 2019, and a minimal requirement for transfer water.

Conservation would be easier to implement at less aggressive levels and would require the least interaction with other agencies. At higher levels (e.g., CPA 3, which takes advantage of early savings due to aggressive near-term programs targeted at East County growth), coordination would be required with wholesale customers to implement such measures. In addition, CPA 3 would reduce sales for those purveyors, so there may be a hesitancy on the part of those agencies to cooperate. Currently, based on District records, typical existing consumption for a single-family residential customer in an average year is approximately 140 gallons per capita per day.

Exhibit 6-4 compares the effect CPA 1 and CPA 3 would have on per capita water use and the additional impact of a drought management program of 15%. Implementation

Exhibit 6-4
Result of Drought Management on Single Family Residential Water Use



* Drought year water use is based upon residential customers accepting a larger share of the burden.

1 Reduction figures represent reductions from current average year use which would result based on an average 15% overall drought management program.

of CPA 3 would restrict per capita use to 106 gallons per capita per day, approximately the drought level usage by single-family customers in 1991. This would require both significant indoor and outdoor savings on a long-term basis. During drought periods, the addition of a 15% drought management program would result in consumption of 80 gallons per capita per day, or 57% of the current average year consumption rate. For this reason, CPA 3 scored lower for implementability than the other conservation programs.

Resource Alternatives 1, 2 and 3 rated Moderate based on their reliance on water transfers during normal and dry years. The complexities of negotiating a contract or combination of contracts with the transferring agencies, obtaining institutional approvals, arranging flexible schedules that respond to environmental and biological requirements, seasonal demand fluctuations, and integration of transfer water through the Los Vaqueros system reduced implementability to a Moderate rating. Although these factors are challenging, transfers among agencies do occur on a regular basis; a Moderate rating was therefore deemed appropriate. Resource Alternative 4 ranked as the most implementable, as minimal normal year transfers are required and all components would be held within the District's service area. No new technology would be required, and CPA 2 appears to be implementable uniformly with measures that could be embraced by the District. Resource Alternatives 5 and 6 scored low for implementability primarily based on the inclusion of CPA 3. Ratings are summarized in Exhibit 6-5.

Exhibit 6-5
Evaluation of Implementability

Alternative	1	2	3	4	5	6
Rating:	MOD.	MOD.	MOD.	HIGH	LOW	LOW

Evaluation of Cost

Several cost analyses were performed for different purposes. A present worth analysis was used to screen all Alternatives to give a fair evaluation of capital and O&M (life-cycle) costs over time.

Economics were evaluated with an analysis of life-cycle costs based on present worth. Details of this economic analysis are presented in Technical Appendix F. A present worth approach was most appropriate for this Study because it allows comparison of Resource Alternatives with multiple components (such as conservation and reclamation) that will be implemented over time, as discussed further toward the end of this Chapter. While the evaluation focused on the year 2020, cost projections spanned the period 1997 to 2040. Evaluation criteria Ec1 (Life-cycle costs) and Ec2 (Rates) needed to be evaluated considering capital, O&M, rate revenue and expenses over time. The cost methodology must factor in the timing and phasing of the Resource Alternatives' various components, including capital, operating and maintenance costs. The present worth methodology facilitated rating components, phased in over time, on a common scale against the criteria.

Costs per acre-foot were developed because that is a parameter that is often presented as the unit cost of water.

Where applicable, the economic analysis incorporated assumptions from the District's existing planning efforts, such as the 10-year Capital Improvement Program (CIP). Assumptions used to calculate present worth costs for the six Resource Alternatives include:

- Annual inflation rate of 4%, consistent with the CIP (Surface water and spot transfers were calculated at a higher rate of 6.5%).

A rate analysis was performed for the detailed screening of the three final Alternatives to compare near-term rate impacts as well as overall costs of a program.

- Discount rate of 6.5% (the rate money will lose value in years to come).
- Facilities have a 30-year life, which represents an average for all facilities including pipelines and structures (which normally have longer lives) and motors and pumps (equipment which typically has shorter life spans).
- Unit costs represent the average over 43 years, 1997-2040, (calculated by dividing the present worth cost for each component by the total water supplied over the 43-year period).
- Facility construction is completed just prior to implementation (facility is constructed as required by demand).
- Unit costs of each component were combined (as appropriate) to develop a per ac-ft cost for each Resource Alternative, representing the average cost for the quantity of water developed for a particular Resource Alternative to the year 2040.

Estimates for implementation costs include consideration of construction, engineering, environmental mitigation, permitting and legal/institutional costs. Present worth costs for the components were calculated based on the period from 1997 to 2040. Reclamation costs ranged depending on year of implementation, as indicated below.

Component	Present Worth Cost ($ per ac-ft)
CVP water	$38
Conservation - CPA 1	$ 161
Conservation - CPA 2	$ 113
Conservation - CPA 3	$ 93
Reclamation	
Project 1 (Central County Urban)	$ 590-631
Project 2 (Antioch Urban)	$ 511-527
Project 3 (Cooling Towers)	$ 431-625
Project 4 (Boiler Feed Water)	$1,087
Surface Water Transfer	$ 198[1]
Spot Surface Water Transfer	$ 340[1]
ECCID Surface Water Transfer	$63

1 These 1997 Present Worth costs have been estimated as a high end scenario. Costs were based on $50 to $175 per ac-ft annually for long-term surface water transfers and $125 to $300 for spot transfers required in drought years, including $40 to $50 ac-ft for pumping and in-Delta restoration charges.

Present worth costs were projected for each Resource Alternative based on the additional needs required for *full* delivery of water in *all* years. For drought years, costs associated with meeting supply shortfalls were computed for two cases: (1) with no short-term demand management program, and (2) with a 15% short-term demand management program. Sensitivity runs were also conducted using varying levels of CVP cutbacks combined with different levels of short-term drought management programs, discussed further in Chapter 7. For cost estimating and implementation schedule analyses, reductions in water supplies attributed to the CVPIA were assumed to occur in the year 2010.

Exhibit 6-6
Evaluation of Present Worth Costs
(in millions of dollars)

Alternative	1	2	3	4	5	6
Cost:	$336	$309	$339	$831	$265	$454

Present worth costs were used to compare and rank the Resource Alternatives. Costs are presented in the most detail for Service Area C but are also discussed generally for the larger Service Areas (E and F). The total cost for each Resource Alternative includes the purchase of spot surface water transfers during drought years. Present worth costs for the Resource Alternatives range between $265 million and $831 million dollars, as shown in Exhibit 6-6. Resource Alternative 4 was the highest cost Resource Alternative based on its reliance on higher levels of reclamation that require extensive treatment[2]. Resource Alternative 5 ranked as the lowest cost, reflecting the long-term cost effectiveness of conservation due to the increased water savings each year. Resource Alternatives 1, 2 and 3 and 5 formed a reasonable cost range between $265 million to $339 million. Resource Alternative 6 fell above this range with a projected cost of $454 million, at least 34% higher than the highest of the other four alternatives. Due to the availability of surface water transfers from ECCID with Service Area E, there are no significant differences between the Resource Alternative components for Service Areas C and E; this implies that selecting a Resource Alternative now for Service Area C will not preclude future expansion of the Service Area.

Unit costs (on a per ac-ft basis) were used to assess implementation issues for each of the six Resource Alternatives, including timing and phasing of projects and components. Implementation factors include the calculation of rate impacts, which—like present worth costs—were calculated over a 43-year period (1997-2040). In general, reclamation projects had the highest per ac-ft cost ($431-$1,087) due to the high cost associated with increased levels of treatment and new distribution systems for urban irrigation[2]. Conservation had the lowest unit costs ($93-$161) due to the increased levels of accumulated water savings. In future decision-making, unit costs will be used as a guideline for the programming and development of specific components.

2 Since the original analysis, Shell/Tosco representatives have recently expressed the potential need for higher quantities of cooling tower water, which could result in lowering the cost of this Alternative by approximately 20% (cooling tower unit costs are less than that of boiler feed water). However, this would still represent a cost of approximately two times the range determined to be reasonable for the District. Since this component was not studied for implementation until the year 2011, this opportunity will be given further consideration and study within future updates of the FWSS.

Selecting a Resource Alternative now for Service Area C will not preclude future expansion of the Service Area.

Exhibit 6-7
Ranking of the Round 2 Resource Alternatives
Service Area C

ALTERNATIVE	1 • CPA 1 • Transfers 64D/38N	2 • CPA 2 • Transfers 57D/31N	3 • CPA 2 • R. 5 TAF • Transfers 52D/26N	4 • CPA 2 • R.30 TAF • Transfers 27D/1N	5 • CPA 3 • Transfers 43D/17N	6 • CPA 3 • R.17 TAF • Transfers 26D/0N
Reliability	High [1]	High [1]	Moderate [3]	Low [6]	Low [6]	Low [6]
Implementability	Moderate [3]	Moderate [3]	Moderate [3]	High [1]	Low [6]	Low [6]
Present Worth Cost	$336M [3]	$309M [2]	$339M [4]	$831M [6]	$265M [1]	$454M [5]
Score	7	6	10	13	13	17

Response to Criteria
- High
- Moderate
- Low
- [3] Ranking

Ranking represents a relative relationship among the six Resource Alternatives studied, to best determine those which would be selected for final analysis.

PRELIMINARY RANKING OF THE ROUND 2 RESOURCE ALTERNATIVES

Exhibit 6-7 displays the preliminary rankings for the six Resource Alternatives. The top block identifies the key components of each Alternative. The rankings are then shown (High, Medium or Low), indicating how each Alternative responded to the key criteria. Numerical rankings were also assigned to help rank the Resource Alternatives relative to each other - 1 indicating a High response, 3 indicating a Moderate response, and 6 noting a Low response. Present worth cost ratings were also assigned to each Alternative. A ranking is therefore associated with the response to criteria or cost for each Resource Alternative.

Preliminary examination of the rankings for each Resource Alternative shows that Resource Alternatives 1 and 2 scored the lowest (most favorable), with combined scores of 7 and 6, respectively. Resource Alternative 3 ranked third, with a combined score of 10 including two Moderate scores. Resource Alternatives 4 and 5, representing the most and least costly Resource Alternatives, ranked next with a combined score of 13. Resource Alternative 6 ranked poorly based on a combined score of 17, with two Low ratings for implementability and reliability.

Based on these preliminary rankings, the District advanced a "shortlist" of the three most promising Resource Alternatives (shown on the left half of Exhibit 6-8) for a more detailed examination as part of Round 2. No one determinant was used to select the Alternatives for further study. However, cost and reliability were important factors in

Exhibit 6-8
Resource Alternatives for Service Area C

Year 2020
(with Assumed CVPIA Reductions of 15%)

Service Area C
Projected Demand: 210 TAF

ALTERNATIVES					
1	2	3	4	5	6
Drought/Normal	Drought/Normal	Drought/Normal	Drought/Normal	Drought/Normal	Drought/Normal
• CVP (140/166 TAF)	• CVP (140/166 TAF)	• CVP (140/166 TAF)	[illegible]	[illegible]	[illegible]
• *[CPA 1 (6 / 6 TAF)]*	• *[CPA 2 (13 / 13 TAF)]*	• *[CPA 2 (13 / 13 TAF)]*	[illegible]	[illegible]	[illegible]
		• Reclamation (5 / 5 TAF)	[illegible]		[illegible]
• Surface Water Transfers/Rights (33-64 / 38 TAF)	• Surface Water Transfers/Rights (26-57 / 31 TAF)	• Surface Water Transfers/Rights (21-52 / 26 TAF)	Surface Water Transfers/Rights [illegible]	Surface Water Transfers/Rights [illegible]	Surface Water Transfers/Rights [illegible]
PRESENT WORTH COST					
$336 M	$309 M	$339 M	$851 M	$265 M	$454 M
COST PER ACRE-FOOT					
$208	$187	$205	$503	$155	$266

the selection process, especially in terms of potential impacts on future rate increases. The majority of the Resource Alternatives fell within a similar range of $265 to $339 million for future water supplies to the year 2040. Resource Alternatives 1, 2, 3 and 5 had present worth costs which fell within a reasonable range for the District. The costs were estimated at $336, $309, $339 and $265 million, respectively. Resource Alternative 3 is approximately 28% higher than Resource Alternative 5. The cost spread among Resource Alternatives 1, 2, and 3 is 10%.

Resource Alternative 4 was clearly outside, approximately 245% above the reasonable cost range discussed above ($265-$339 million). This was primarily due to the high cost of including industrial boiler feed and cooling tower make-up water as a reclamation component. Boiler feed water was included to maximize efficient use of recycled water within the District. However, due to the reverse osmosis system required for demineralization, unit costs were very high ($1,087), which drove up the cost of the Alternative. For this reason, Resource Alternative 4 was dropped from further consideration in the near term. Costs for Resource Alternative 6 were also found to be high at $454 million. This was largely due again to reclamation costs. In future updates of the FWSS, reclamation should be revisited as a possible component, as advanced wastewater treatment technology is continually advancing. In addition, industries may increasingly move in this direction to benefit their own systems by increasing water quality, consistency and reliability, if joint funding with other agencies could provide a more cost-effective means to develop such projects.

The preliminary screening process revealed serious flaws in some of the Round 2 Resource Alternatives. As illustrated in Exhibit 6-7, Low scores were assigned to Resource Alternatives 4, 5 and 6 for reliability and/or implementability; Resource Alternatives 5 and 6 scored Low on both these criteria. Based on these Low scores, the District dropped the Resource Alternatives 4, 5, and 6 from further consideration during this stage of the FWSS. Individual components of these Resource Alternatives, however, may prove useful in future evaluations and updates of the FWSS.

FURTHER EVALUATION OF THE RESOURCE ALTERNATIVES

Evaluation of the remaining three Resource Alternatives (i.e., 1, 2 and 3) focused on rate impacts, as well as the trade-offs between reliability, costs and implementability. Based on results of this more detailed analysis, the District identified a Recommended Preferred Alternative with the widest acceptability; more detail regarding the Recommended Preferred Alternative is provided in Chapter 7. The Recommended Preferred Alternative will ensure flexibility in responding to changing demand relative to project implementation, phasing and schedules.

Delivery Assumptions

Earlier overall assumptions regarding delivery scenarios remained the same during the further evaluation of Round 2 Resource Alternatives. A 15% reduction in CVPIA supplies during a normal year and further reductions during drought were assumed to occur in the year 2010, sharply increasing the need for water. DWRSIM output indicates that CVP M&I customers, including CCWD, would be subject to drought reductions on average in one out of every seven years. The need for additional water in normal and drought years for the year 2020 was calculated under three year types as discussed in

Chapter 5 (i.e., normal, drought, and drought with a 15% reduction). A normal year would require an additional 43,500 ac-ft of water, and a drought year would require an additional 69,500 ac-ft (if meeting 100% demand), or 38,100 ac-ft if the District chose to meet only 85% of demand. In the year 2020, the difference between meeting full delivery during a normal and drought year under projected demand would be 26,000 ac-ft. The difference between meeting 100% and only 85% of demand during a drought year would be 31,400 ac-ft.

Conservation and Reclamation Components

Conservation savings are estimated conservatively. Increased savings could potentially be achieved through the implementation of CPA 1 without the additional funding required by CPA 2, depending on the design and success of the program.

CPAs 1 and 2 were included as components of all three remaining Resource Alternatives. CPAs 1 and 2 would reduce 2040 water use by 5 and 9%, respectively. These savings are in addition to the No Action Alternative conservation savings of 10% in the year 2040. CPA 1 or 2 would be implemented in the year 1997. The potential for demand hardening with each of these programs is discussed in further detail in Technical Appendix C. A water reclamation component is included in Resource Alternative 3 and was slightly increased (by 1.7 TAF) from the preliminary evaluation to provide a drought-proof supply equal to 15% of demand for cooling tower make-up by industrial users. It includes the Central County Urban Irrigation (1.7 TAF) and Antioch Urban Irrigation (2.1 TAF) projects and 15% of the water required by Industrial cooling towers (1.7 TAF), for a total potable water savings of 6.7 TAF. Phase 1 of the Central County Urban Irrigation project (0.8 TAF) is currently being implemented by the Central Contra Costa Sanitary District, and included within the total savings. Savings associated with the Phase 1 project will be realized starting in 1997 with full deliveries in 2008; however, the remaining phases and the Antioch project may not be implemented until 2017.

Water Transfer and Water Storage Components

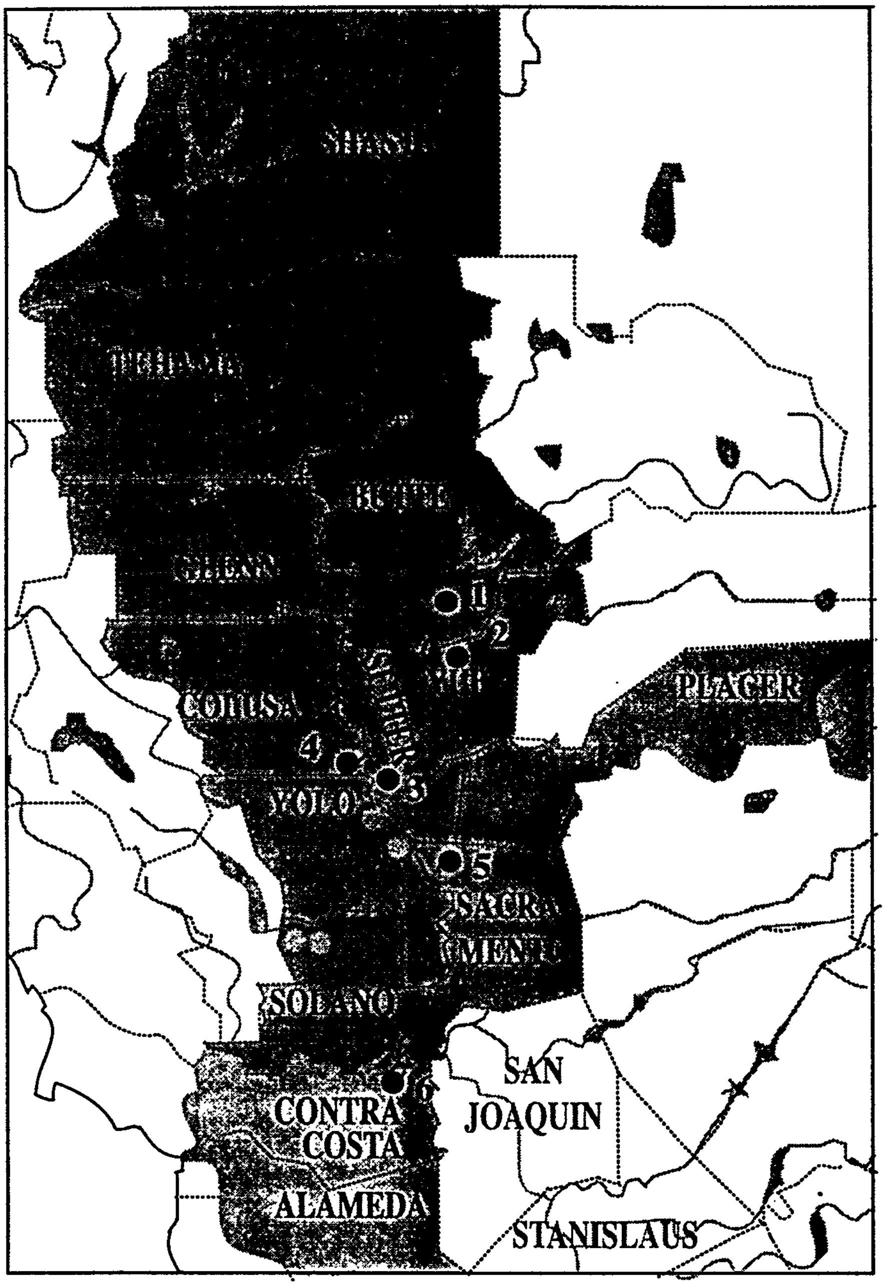
The District identified a preferred list of potential water transfer opportunities, narrowing the total 84 regional supply sources to the six most promising candidates based on current market availability. The original list of transfer sources (out-of-county) was screened with Criteria O1 and I3. Water transfer screening was based primarily on the availability and willingness of a water agency to transfer water. Criterion I3 (Ensure proper timing and phasing), including transfer quantity, delivery schedule and implementability, was recognized as the most influential criterion for this level of screening, based on water agencies' past and present activities on the water market and information on potential projects that could be implemented to produce a transferable supply.

The identification of a potential source of water supply in this Study does not imply a willingness to develop or provide resources to CCWD by a participating agency or project.

The sources listed below and presented in Exhibit 6-9 are believed to be the most implementable today. The first five potential transfer opportunities originate within the Sacramento Valley and would rely primarily on natural water courses to deliver the transferred water through the Delta to the District's intake facilities. These sources are considered strong based on their availability and willingness to market water for sale in recent years. The six identified sources include:

Oroville-Wyandotte Irrigation District
Yuba County Water Agency
Sutter Mutual Water Company
Reclamation District 108
Natomas Central Mutual Water Company
East County/Delta Sources

Exhibit 6-9
Potential Supply Sources



1. Oroville-Wyandotte Irrigation District
2. Yuba County Water Agency
3. Sutter Mutual Water Company
4. Reclamation District 108
5. Natomas Central Mututal Water Company
6. East County/Delta Sources

)-16

The transfer sources identified are believed to be the most implementable for the District today given available information, but are subject to change.

The transfer market, driven by supply and demand, is constantly changing. These recommendations are based on today's environment; six months from now this list could change. Other sources should continue to be examined and revisited during future updates of the FWSS. Further discussion of these sources is included in Technical Appendices D and E.

All sources are assumed to be available on a short term or long term basis. The District's immediate need is for drought year supplies; however, this will change if CVP entitlements are reduced between the years 2000 and 2010. The recommended strategy is to pursue a long term annual transfer available for use in future non-drought years, and in the interim years, when the District would not have a use for supplemental water, the District could: (1) remarket the transfer water to agricultural, municipal or environmental users; (2) bank the transfer water in a groundwater banking facility; or (3) do a combination of both.

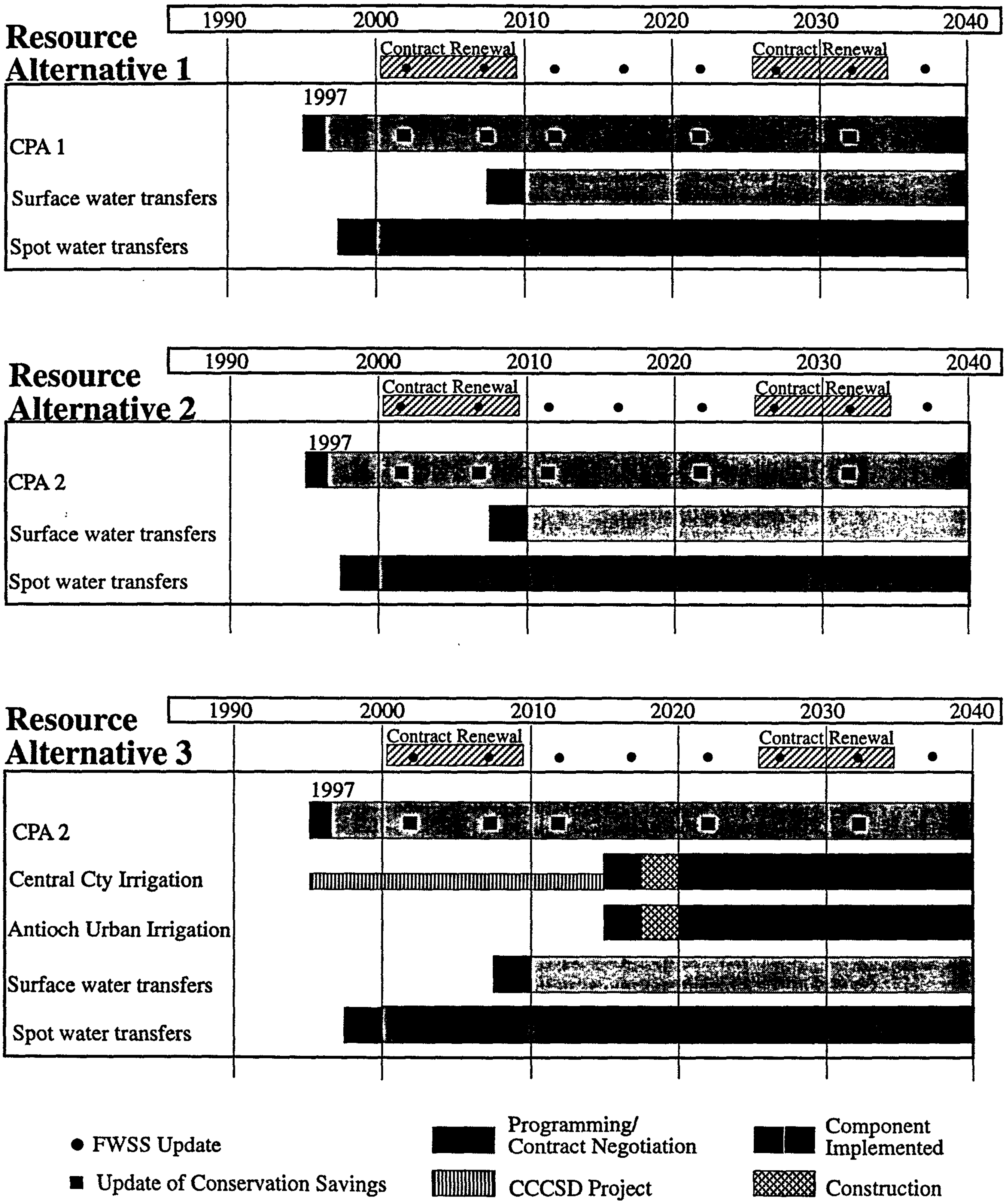
Specific water transfer candidates will be pursued after selection of the Preferred Alternative and establishment of an implementation strategy and timeline. In addition, storage opportunities would be pursued and coordinated with potential transfer opportunities. Groundwater storage provides the most potential at this time due to existing viability of options and lower cost, as opposed to a new surface storage project. The District could implement water transfers in all years and deliver the volume in excess of their normal year supplemental needs to a groundwater bank. The water banking opportunities studied exhibit similar environmental implications and similar implementability. The two most promising storage components under consideration are Madera Ranch in Madera County and Semitropic Water Storage in Kern County. Further discussion of these two opportunities is included in Technical Appendix D.

Environmental Considerations Associated with Surface Water Transfers

All transfer opportunities could result in minimal adverse and beneficial impacts to upstream users and would not result in any substantive land use changes. Upstream impacts are considered minimal because: (1) the proposed transfer amounts are a small percentage of the overall inflow to the Delta; and (2) the assumption that proposed transfer water is "excess" water for the agency which would either flow into the Delta anyway, or remain as carryover storage in upstream reservoirs.

The schedule of a transfer for a specific source would be optimized with the District's seasonal requirements to the greatest extent possible. Environmental requirements, especially within the Delta; will be important in negotiating a schedule that balances the District's needs with environmental considerations. Some of the potential transfers could increase streamflows between the source and the District. Reducing upstream diversions and increasing river flow would generally have the greatest environmental benefits during April through June and September through October, when the juvenile salmonids and adult winter-run chinook salmon are migrating. The least benefit to upstream fish would occur in July and August. Most of the transfer sources identified above take delivery of water from April through October. Therefore, the District would most likely take delivery during that period; however, delivery could be negotiated to correspond to fishery and aquatic needs.

Exhibit 6-10
Implementation Timelines



Implementation and Phasing Plans for Resource Alternatives

Exhibit 6-10 illustrates the Resource Alternatives' preliminary timelines. The timelines focus on development of conservation programming, planning and construction of reclamation projects, and investigation and contract negotiations for water transfer purchases. The FWSS should be reviewed and updated periodically; the first update would occur around the year 2002. Updates at 5-year intervals over the 50-year study period were used to plot critical development paths for decision-making, and refine the timing of environmental documentation, engineering design, environmental compliance and construction for project components. Implementation of facilities would be synchronized to meet projected future demand. Key decision-making points are noted on the timelines. During these reviews, actual and projected demand and conservation savings are compared so that overall adjustments can be made to the plan. Such adjustments could include different or additional conservation measures, rescheduling of reclamation projects and potential development of water banking programs.

RATE IMPACT ANALYSIS

The purpose of the rate impact analysis is to determine how the cost of various Resource Alternatives will affect customer water bills. Resource Alternatives 1, 2 and 3 were evaluated, each with different capital and operating costs. Impacts of the programs were assessed and compared to determine whether a program or group of programs adversely impacts rate payers. Rate impacts were developed using many of the same assumptions stated earlier for development of the present worth costs:

- Annual inflation rate of 4% (6.5% for water transfers) on O&M and capital costs.
- 30-year bond life for major capital at 6.5% interest rate.
- 1995-96 10-Year Rate Analysis as basis for current volume, costs and rates.
- Interest on bond/cash reserve balances consistent with the 10-Year Rate Analysis.

For more details on assumptions and the rate model, see Technical Appendix F.

Methodology

The rate impact analysis spans 43 years of the Study (1997-2040). The District's rate model was used to derive revenue requirements. The first step was to identify the total District costs for O&M, debt service on borrowed capital, and capital programs funded directly from revenues for Resource Alternatives 1, 2 and 3. The District's Capital Improvement Program (CIP) forms the basis of the capital programs with dollar amounts extrapolated to cover the full Study period. These are then offset with appropriate revenues from rates for raw water facilities, interest earnings on fund balances, property taxes, and miscellaneous revenues, resulting in the net revenue requirements funded from water rate revenues. To compare Resource Alternatives, the total revenue requirements from water rates were derived for each Resource Alternative and then expressed in cost per ac-ft.

Results of the Rate Impact Analysis

Exhibit 6-11 summarizes rate impacts from implementing Resource Alternatives 1, 2 and 3, showing cost per ac-ft for future and 1996 dollars. The 1996 dollars were derived by dividing all future year costs by the compounded inflation rate to that year. Each cost is based on meeting 100% of demand.

Exhibit 6-11
Summary of Resource Alternative Costs

Alternative Costs Basis		2000 ($ per ac-ft)	2020 ($ per ac-ft)	2040 ($ per ac-ft)
10-Year CIP/ Rate Analysis[1]	*Future$*	*827*		
	1996$	*680*		
Resource Alternative 1	Future$	838	1,381	2,739
	1996$	689	518	469
Resource Alternative 2	Future$	856	1,408	2,745
	1996$	703	528	470
Resource Alternative 3	Future$	856	1,479	2,790
	1996$	703	555	478

Note: Chart reflects total District costs assuming Resource Alternatives 1, 2 or 3.

[1] Shown for comparative purposes only. 10-Year CIP/Rate Analysis costs do not include the provision of drought year supplies.

As the current cost of CVP water is very favorable, all sources of additional supply are more costly than the current costs. CVP water accounts for 83% of all water supplies planned to meet demand over the study period. In 2020, the increase in cost for the Resource Alternatives above the 10-Year CIP/Rate Analysis is between $118 and $216 per ac-ft in future dollars, and $44 and $81 per ac-ft in 1996 dollars. However, the costs shown for the 10-Year CIP/Rate Analysis do not meet the water needs of the District, as drought year supplies are not included within the cost and therefore would not meet demands. In 2040, the increase in cost above the 10-Year CIP/Rate Analysis is between $680 and $731 per ac-ft in future dollars and $116 and $125 per ac-ft in 1996 dollars.

Rate analysis indicates that implementation of the Preferred Alternative would not result in additional impacts on rates because the current rate structure includes a placeholder of 20 million dollars for the next 10 years for the purchase or transfer of water rights.

The nominal increase in real cost is primarily due to the fact that the entire incremental cost is for only about 30,000 ac-ft of additional supply, about 17% of total demand. For this reason, on a melded cost basis, the high cost of incremental supply is substantially diluted by the base level CVP water cost (83%). The key finding of the analysis is that, using a melded cost approach in future or 1996 dollars, there is little difference among Resource Alternatives and that any one, or combination of alternatives, could be selected without unduly affecting water rates as compared to the current 10-Year CIP/ Rate Analysis.

Costs Associated with Drought Management

The rate model also examined the costs of meeting a potential cutback of supply in drought years through a drought management program rather than with spot purchased water transfers. The cost per ac-ft with drought management in drought years is higher than without drought management. Two factors contribute to this result: (1) drought management promotion and implementation costs, set at $500,000 plus inflation of 4%; and (2) lower volume by 15%, which reduces water sales (fixed costs of production do not decline with decreases in volume). These cost increases are partially offset, however, as costs are reduced by not having to buy spot water transfers.

Reduced Cost of Water Transfers

The District has asked the Bureau to negotiate an agreement that would allow the purchase and transfer of the Contra Costa Canal and other conveyance facilities currently used by CCWD. This agreement would give the District more control over the use of facilities and greater flexibility and lower costs in moving transfer water. If the District can negotiate the Canal purchase, the assumed cost of a transfer would be reduced by approximately $20 per ac-ft. The savings for each Resource Alternative would depend on the amount of transfer water required. The costs of Resource Alternative 1 would be reduced the most due to its greater reliance on surface water transfers (38 TAF in 2020). Costs of Resource Alternative 2 (which includes 31 TAF in transfer water) and Resource Alternative 3 (which includes 24 TAF) would be decreased by smaller increments. However, these differences are not particularly significant when comparing total present worth costs ranging from $309 to $351 million (cost for Resource Alternative 3 increased from earlier evaluation based on 1.7 TAF increase in reclamation), and would result in only minor differences in comparing the rate revenue for the three Resource Alternatives.

SCREENING AND RANKING THE REMAINING RESOURCE ALTERNATIVES

The remaining three Resource Alternatives were evaluated in further detail, including a rate analysis. The rankings against the key criteria for the three Alternatives were relative to one other.

The remaining three Resource Alternatives were evaluated and ranked against the key criteria relative to each other The earlier ranking displayed in Exhibit 6-7, was based on the relative relationship among the six Resource Alternatives. The evaluation of the remaining three Resource Alternatives against the criteria was based on more detail, including a rate analysis that identified near-term costs, benefits and overall program costs. In addition, the trade-offs between economics, reliability and implementability were examined. In identifying the Recommended Preferred Alternative, reliability, implementability and economic criteria were considered equally. Results of the further refined Round 2 analysis are summarized below.

Evaluation of Cost

The present worth costs of the three Resource Alternatives were presented earlier in this Chapter. Based on this analysis, Resource Alternative 2 ranks the highest (i.e., lowest cost- $309 million), followed by Resource Alternative 1 ($336 million) and Resource Alternative 3 ($351 million based on the 1.7 TAF increase in reclamation). The lower costs of Resource Alternative 2 are associated with the low present worth cost of CPA 2. Higher levels of conservation have lower present worth costs as a result of an accumulation of demand reduction (water gained) over a long period of time. The higher treatment costs associated with the reclamation projects included in Resource Alternative 3 contribute to its higher cost.

Based on the rate analysis model, there are only minor differences between the three Resource Alternatives when comparing the costs for 2040. Near-term (2000) costs however, are less for Resource Alternative 1, which is shown only slightly above those costs currently projected for the District's 10-year CIP/Rate Analysis. Through 2010, the only difference is that Resource Alternatives 2 and 3 include CPA 2. In 2010, the cost per ac-ft difference between Resource Alternatives 1 and 2 is $36/ac-ft in future dollars ($20/ac-ft in 1996 dollars). In 2040, the difference is only $6/ac-ft in future dollars ($1/ac-ft in 1996 dollars). The diminishing difference primarily reflects the accumulation of conservation savings over the study period. The net effect of the two conservation programs is trivial expressed in cost per ac-ft when looking at the entire study period. But because near-term costs are less for Resource Alternative 1, it is recommended that the District begin implementation of CPA 1 in 1997 and move into CPA 2 in the future, should it become necessary.

Evaluation of Implementability

The key to implementation of the Resource Alternatives is the water transfer component. Transfers, while complex to negotiate, have become more commonplace in the last five years. However, there are unique intricacies associated with the terms and conditions of any transfer. As all three Resource Alternatives require transfers of approximately the same magnitude (24-38 TAF by 2020), no substantial implementation differences are foreseen; therefore, evaluations regarding implementability were based primarily on the conservation programs included within the alternatives. The three Resource Alternatives contain either CPA 1 or 2 as a component. Although both programs are perceived as reasonable to implement, CPA 1 would require less effort from District customers and retail agencies and consequently would be easier to implement. The reclamation project included in Resource Alternative 3 is not expected to create any implementation obstacles; however, it would require additional negotiations with wastewater agencies and potential customers. It is therefore considered slightly more difficult to implement. Resource Alternative 1 ranked the highest, followed by Resource Alternatives 2 and 3 (moderate). Exhibit 6-12 displays rankings for the three remaining alternatives.

Exhibit 6-12
Ranking of the Remaining Resource Alternatives

RESOURCE ALTERNATIVE	1 • CPA 1 • Transfers 64D / 38N	2 • CPA 2 • Transfers 57D / 31N	3 • CPA 2 • R. 6.7 TAF • Transfers 50D / 24N
Reliability			
Technical	● [1]	● [1]	◒ [3]
Drought	● [1]	◒ [3]	◒ [3]
Implementability	● [1]	◒ [3]	◒ [3]
Present Worth Cost	$336M [3]	$309M [1]	$351M[1] [3]
Near-term (2000/2020) Rate Analysis (1996$)	$689/ac-ft $518/ac-ft [1]	$703/ac-ft $528/ac-ft [3]	$703/ac-ft $555/ac-ft [3]
Score	7	11	15

Response to Criteria
● High
◒ Moderate
○ Low
[3] Ranking

[1] The increased cost from $339, shown in the earlier Exhibit 6-7, to the $351 reflected for this Alternative in the Exhibit above, is due to the addition of 1.7 TAF in reclamation which was included to increase the reliability of Alternative 3.

Ranking is a result of further refinement, identifying a relative ranking among the three Resource Alternatives.

Evaluation of Reliability

Reliability can be viewed in two terms: technical reliability and drought reliability, each with its own implications. Technical reliability was reviewed with respect to operations, compatibility with the District's existing facilities and infrastructure. The more complex the facilities and technology involved, the greater the potential for complications in terms of technical reliability.

Drought reliability could be improved for all three of the remaining Resource Alternatives through the use of water banking although banking is not considered necessary for near-term solutions. However, the Implementation Plan for the Recommended Preferred Alternative should include periodic consideration and evaluation of water banking for future drought conditions. Water banking could be implemented in a number of ways. Instead of purchasing supplemental water as a spot transfer, the District could purchase a long-term transfer or entitlement and bank the water. The District would store the contracted quantity of water during wet and normal years and then use the stored water during drought years. The drought reliability of all three Resource Alternatives significantly increases with the use of water banking. However, costs increase as well.

The implications of poor drought reliability vary depending on how the District responds to drought shortages. Implementation of a drought management program can result in widespread indirect costs to the District and its customers. District costs include the cost of the drought management efforts, as well as reduced sales. Customer costs include the loss of landscaping and recreational opportunities, as well as a loss of jobs in the landscape and nursery industry. Drought contingency plans for the Recommended Preferred Alternative for the short and long term are addressed in Chapter 7.

Resource Alternatives 1 and 2 are ranked High for technical reliability, while Alternative 3 ranked Moderate. Alternative 1, which includes CPA 1, has a higher drought reliability than Resource Alternatives 2 and 3, which include CPA 2 and rank equally. Because CPA 1 is a less aggressive conservation program, there are more opportunities for customers to make additional cutbacks during droughts. Therefore, it is easier for customers to respond to drought shortages with CPA 1 than with CPA 2.

Cost vs. Implementation

Implementability can be a key factor in keeping down the costs of any proposed additional supplies. Potential impacts perceived to affect the environment and other communities can extend the time needed for environmental documentation, engineering design, environmental compliance, and construction of proposed facilities. In general, the greater the time and number of agencies involved, the higher the direct and indirect costs to implement such a project. In the case of Alternatives 1,2, and 3, differences in costs due to implementation are not expected to be significant in terms of transfer water. Resource Alternative 3 would likely require the greatest implementation hurdles due to the combination of reclamation, CPA 2 and a water transfer of significant size.

Cost vs. Reliability

Reliability was discussed earlier in terms of technical reliability. The issue of cost as it relates to drought reliability was also discussed based on the relationship between conservation programs, additional drought management and the potential for avoided costs.

The use of water banking has a significant positive effect on reliability and correspondingly increases costs. Conversely, a lack of reliability within a system can have significant costs to District customers.

Lack of reliability within a system can result in a variety of implications depending on the District's reaction. Although Alternatives 1, 2 and 3 are considered reliable at this point in time, issues of reliability will continue to require revisiting in future updates. The implementation of drought management necessitated by a shortage of supplies can bring about widespread indirect costs. Such economic considerations include the cost of the drought management program itself, as well as the temporary loss of jobs within the landscape sector, replacement of landscaping, loss of recreational opportunities, damage to fish and wildlife, and reduced sales to the District.

Water Quality Considerations and Level of Demand in Terms of the Los Vaqueros Project

As discussed in Chapter 3, the demand projections used in the Los Vaqueros Project environmental documentation were developed for what is described here as Service Area A. Estimated 2025 demand in the Los Vaqueros Project analysis is 205,800 ac-ft per year, not including the estimated 3,000 ac-ft/yr service area demand met by local groundwater. From this gross demand level, the Los Vaqueros Project analysis deducted 17,800 ac-ft per year, which was the estimated 2025 level of combined conservation and reclamation, reducing the estimate to a net demand of 188,000 ac-ft/yr.

The FWSS found 2025 demand for Service Area A of approximately 198,700 ac-ft per year (interpolated from 2020 and 2030). This level includes conservation that would occur regardless of District actions. When additional conservation of CPA 1 is taken
5-24 into account, the 2025 level is 192,000 ac-ft/yr. The minimum level of reclamation in 2025 will be 1,000 ac-ft/yr (Zone One Landscape Irrigation Project). Assuming 3,000 ac-ft/yr will continue to be met by local groundwater, the net demand estimated for 2025 by this study is about 188,000 ac-ft/yr for Service Area A. This is nearly identical to that of the Los Vaqueros Project analysis. Any additional reclamation or conservation would put demand below the Los Vaqueros Project estimates.

By 2040, this Study found Service Area A demand to be about 202,400 ac-ft/yr. When CPA 1 is taken into account, the level is reduced to about 192,000 ac-ft/yr, nearly the same as the 2025 level. Consequently, growth in Service Area A, combined with CPA 1, would have no significant impacts on the Los Vaqueros Project's ability to meet its water quality goals.

This is not necessarily true for other Service Areas. Service Area C, for example, includes planning areas outside current District boundaries and outside the Los Vaqueros Project planning area. Estimated 2025 and 2040 demands for Service Area C are both about 205,500 ac-ft/yr (when CPA 1 is taken into account). These levels exceed those of the Los Vaqueros Project analysis, in large part because they include areas outside the Los Vaqueros Project planning area. This level of demand would affect the Los Vaqueros Project operations (such as meeting water quality goals and sufficiency of emergency reserve) to some degree. The environmental documentation associated with the development of areas outside the Los Vaqueros Project Planning area would have to address any such impacts and propose appropriate mitigation measures.

IDENTIFYING THE PREFERRED ALTERNATIVE

A balanced, long-term plan which provides reliability and flexibility is the best solution to the District's need for additional water. The ideal strategy would provide CCWD with supplemental water during drought years, yet allow the District to market surplus supplies during normal and wet years. A reliable supply would meet demand in most years, especially drier years and in the summer. The Preferred Alternative must be implementable. An environmentally responsible alternative would allow opportunities to provide environmental benefits in the Delta. The lowest cost possible would include lifecycle costs as well as rates.

Additionally, the savings estimated for the conservation programs are conservative; CPA 1 is less costly in the short term and increased savings could potentially be achieved through implementation of CPA 1 without the additional funding required by CPA 2, depending on the design and success of the program.

The Preferred Alternative, therefore, is a resource strategy that allows for a mix of components to be implemented over time and includes periodic updates. Its near-term Action Plan begins with the components within Resource Alternative 1: the current contract for CVP water, implementation of conservation (CPA 1) in 1997, and the simultaneous pursuit of at least six transfer sources as soon as practical.

The District has identified Resource Alternative 1 as the Preferred Alternative based on its higher ratings on implementability and reliability. Preliminary rate impact screening revealed that rate impacts associated with the three Resource Alternatives are similar. Consequently, a more detailed review of the Preferred Alternative in relation to the rate impacts associated with different strategies for obtaining transfer water in a drought year is included in Chapter 7.

A Resource Alternative including CPA 1 was chosen over those including CPA 2 because the less aggressive conservation program is more implementable and more reliable on a District-wide basis. Additionally, the savings estimated for the programs are conservative; CPA 1 is less costly in the short term and increased savings could potentially be achieved through implementation of CPA 1 without the additional funding required by CPA 2, depending on the design and success of the program. Reclamation was not included at this time due to its high capital and O&M costs; it is more cost-effective as a continuous source , rather than as a drought year supply. Reclamation will continue to be reexamined in future FWSS updates and/or as new technology becomes available.

The Preferred Alternative leaves open future opportunities to increase conservation and pursue reclamation projects, depending on the success of the components, growth in the District's service area, and/or further reductions in supplies. Although the near-term Action Plan currently resembles Resource Alternative 1, in the future the plan may grow to resemble Resource Alternative 2 or 3 if periodic updates of the Study reveal the need to implement additional components.

7. The Implementation Plan

OVERVIEW

This chapter discusses implementation of the Preferred Alternative identified in Chapter 6. When identifying the Preferred Alternative, the District sought: (1) a reliable supply, which would minimize the likelihood of shortages (criterion O1); (2) the lowest cost possible, which would include lifecycle costs as well as rate impacts (criteria Ec1 and Ec2); and (3) an environmentally responsible alternative that would minimize impacts or possibly provide environmental benefits in the Delta (criteria En1 and En2). The Preferred Alternative must be implementable (criterion I3) in terms of institutional, environmental, and cost requirements. The Preferred Alternative, therefore, is a resource strategy that allows for a mix of components to be implemented over time and includes periodic updates. If selected, the Preferred Alternative will become the District's Implementation Plan.

As any plan considered by the District must be flexible to respond to changing conditions, the Implementation Plan will consist of both a near-term Action Plan to meet demand in the near term, as well as a long-term Implementation Schedule to respond to changing conditions through the year 2040. Key components of the near-term Action Plan include conservation, water transfers, drought contingency planning, and cost and rate considerations. Key components of the long-term Implementation Schedule include CVPIA reductions and contract renewal, and considerations related to periodic review and updates to the FWSS. These components are summarized below.

NEAR-TERM ACTION PLAN

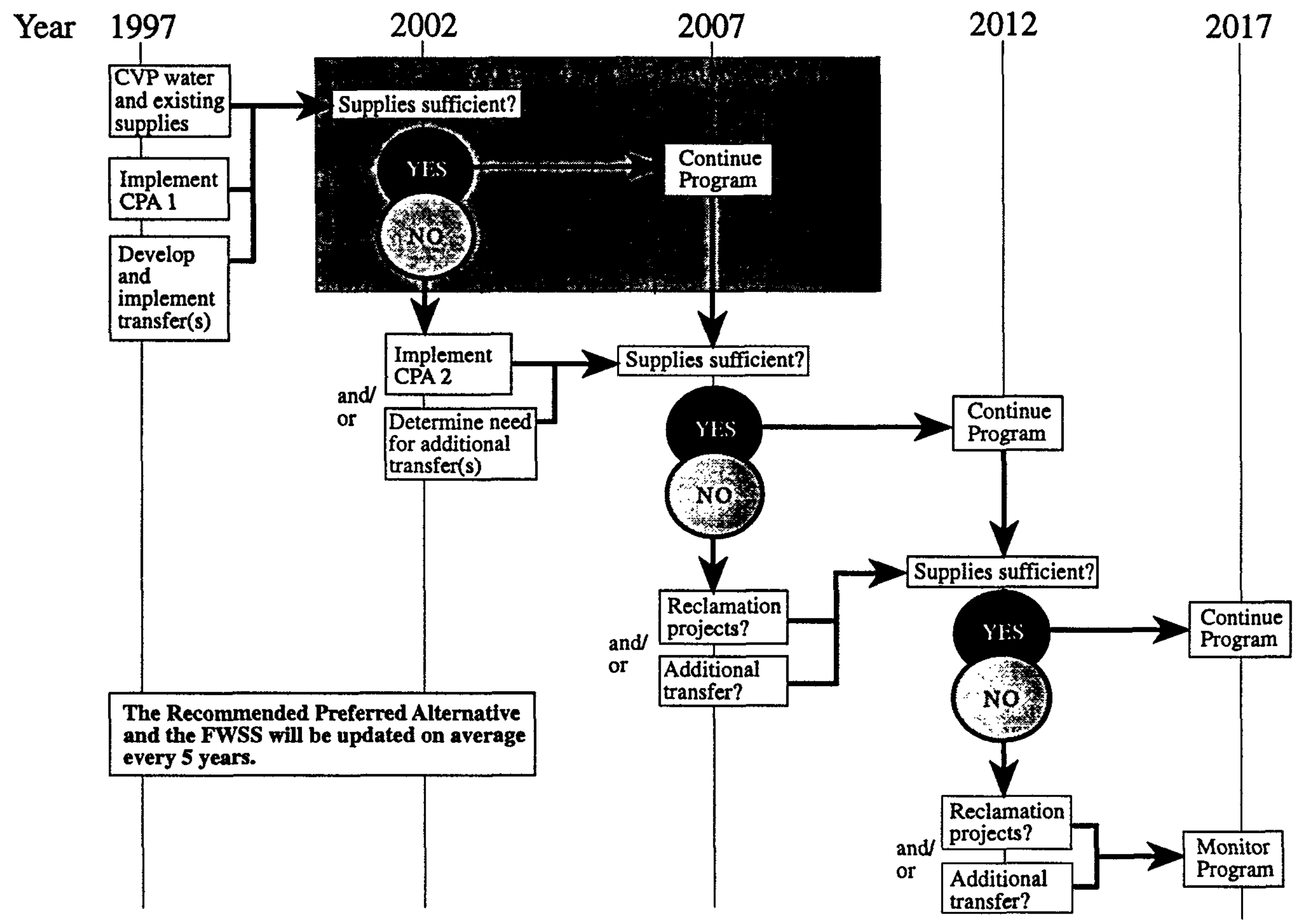
The Preferred Alternative should be implemented in phases to meet the growing shortages that will occur in the future, to allow for flexibility in meeting future demand, and to facilitate periodic updates. Exhibit 7-1 displays the manner in which phasing allows the District to respond to near-term needs. Phasing also provides drought reliability to existing customers with a new transfer as well as accommodating future water needs as the customer base continues to grow. Consequently, the Implementation Plan is divided into a near-term Action Plan and a long-term Implementation Schedule.

Components of the near-term Action Plan include the current contract for CVP water, implementation of Conservation Program Alternative 1 in 1997, and the simultaneous pursuit of (at least) the following six transfer sources for sufficient quantities as soon as practical to meet dry-year shortages of the District:

The transfer sources identified are believed to be the most implementable for the District today given available information, but are subject to change in the near future.

Oroville-Wyandotte Irrigation District
Yuba County Water Agency
Sutter Mutual Water Company
Reclamation District 108
Natomas Central Mutual Water Company
East County/Delta Sources

Exhibit 7-1
Near-term Action Plan for the Preferred Alternative



The following sections discuss the implementation of the near-term Action Plan based on the components within the Preferred Alternative, their relationship to the District's drought contingency plan, and associated capital, operations and maintenance costs.

CVP Contract

The CVP contracted supplies for the near-term, 195,000 ac-ft in a normal year, are deemed adequate. Supplies in a drought year would be limited to a minimum of 75% of historical use, and would likely result in a shortage to the District. The contract expires in 2010, but the CVPIA encourages, through penalty charges, early renewal. The District could opt to wait until the year 2010 to renegotiate the contract based on the quantity of water, if any, that needs to be replaced. However, it may be advantageous for the District to negotiate earlier with the Bureau. The decision will be weighed based on the reduced amount available under a new contract and the costs (due to CVPIA) of $20 per ac-ft (1996) for failure to renew early.

In the near term, the District will need to evaluate the likely conditions in a renewed contract (based on the CVPIA PEIS and the Bureau's regulations implementing the CVPIA), the cost of renewal, and the potential and cost for replacement with transfer water. In any event, the District will need to implement CPA 1 and seek transfers for shortage periods.

Steps to be taken during a renewal will include development of programmatic environmental documentation (which would include analysis of the entire water supply program) to satisfy both the requirements for CVP renewal and most aspects of water transfers (project specific documentation would deal with impacts of a specific transfer). In addition, documentation would be developed as meeting the requirements of the Fish and Wildlife Coordination Act and consultation with Federal and State fisheries agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service and the California Department of Fish and Game).

Issues to be addressed in the contract negotiations would include 1) contract entitlement; 2) the Delta Protection Act; 3) shortage provisions; 4) credits for reclamation and conservation; 5) implementation of the CVPIA requirements; 6) and water costs.

CPA1 is less costly in the short term, and since the water savings are conservative, additional water savings could potentially be achieved without the additional funding required for CPA 2.

Implementation of CPA 1

CPA 1 expands the District's current conservation efforts to encompass wholesale and retail customers. It is consistent with currently mandated BMPs and achieves an overall District-wide reduction of 5% in the year 2040. This is in addition to the No Action conservation savings of between 6 and 10%. These savings will result from State and Federal regulations and the normal replacement of fixtures and devices with more water efficient models.

"Do conservation costs include the staff to implement demand management?"

CFG Comment 11/1/95

Staffing Requirements. Staffing levels will increase between now and the year 2020 and then drop off very slightly in the year 2040. Existing staff will be fully utilized before any new staff are hired. It is anticipated that a total of six new staff will be required by the year 2000. The schedule for hiring new staff between now and the year 2000 is presented in Exhibit 7-2. Exhibit 7-3 presents the full-time equivalent staffing required to implement CPA 1 in the years 2000, 2020 and 2040. Both permanent and temporary employees will be used and not all of the 11.3 staff will report to the Conservation Office; for example, some may be employed in Public Information. Not all need be employed by CCWD. Cooperative arrangements with raw water customers could be made to integrate and/or coordinate activities. This would be addressed in the development of an Implementation Plan that would address coordination with raw water customers.

Exhibit 7-2
CPA 1 Staffing Schedule

Current Staffing	1997	1998	1999	2000
5.3	6.3	7.3	8.3	11.3

Conservation Program Targets. While CPA 1 will achieve a District-wide 5% reduction in the year 2040, different reduction goals will be achieved by each of the major customer categories. These reduction goals are presented in Exhibit 7-4. Reductions for CPA 2 and CPA 3 are also shown, as the District could eventually move toward such programs in the future as a result of updating the Preferred Alternative. In addition to the program targets, individual measures will achieve different coverage levels as well. Coverage

Exhibit 7-3
Staffing Requirements for CPA 1

	CPA 1 - Year 2000				CPA 1 - Year 2020				CPA 1 - Year 2040			
Conservation Measures	P1	P2	P3	T	P1	P2	P3	T	P1	P2	P3	T
Public Information	1.0		0.5		1.0		0.5		1.0		0.5	
Pricing and Incentives												
Ordinances/Plan Reviews		0.1				0.2				0.3		
Audits												
Residential		1.9	0.9	3.7		2.3	1.2	4.7		2.6	1.3	5.1
Commercial & Lt Industrial		0.8		1.1		1.3		1.7		1.5		1.9
Large Turf		1.3		1.8		2.1		2.7		2.3		3.1
Industrial		Consultants will be used.				Consultants will be used.				Consultants will be used.		
Audit SubTotal		**4.0**	**0.9**	**6.6**		**5.7**	**1.2**	**9.1**		**6.4**	**1.3**	**10.1**
ULFT Rebate Program		1.0		1.0		1.0		1.0		Measure ends in 2020.		
Total Staff	1.0	5.1	1.4	7.6	1.0	6.9	1.7	10.1	1.0	6.7	1.8	10.1
Full Time Equivalent (FTE)	**1.0**	**5.1**	**1.4**	**3.8**	**1.0**	**6.9**	**1.7**	**5.1**	**1.0**	**6.7**	**1.8**	**5.1**
		Total FTE =		**11.3**		**Total FTE =**		**14.7**		**Total FTE =**		**14.6**

Note: The System Operation and Loss Reduction Measure would add 1 maintenance staff to each of the totals, see Technical Appendix C.

Permanent Staff (P)
P1 - Program Administrator
P2 - Conservation Specialist
P3 - Conservation Specialist

Temporary Staff (T)
T - Auditors

Temporary staff are half-time.

refers to the percentage of households or accounts affected by a conservation measure. Coverage percentages are based on the expected number of households that could be reached given the cost breakdowns and overall savings targets for each program. For example, the Residential Audit program under CPA 1 will achieve over 22% coverage in the Single and Multi Family sectors by the year 2040. Year 2040 coverage for the Non-Residential Audit Programs will reach over 33%. It is estimated that the Model Landscape Ordinances and Landscape Guidelines will result in 15% coverage of new Residential accounts and 10% coverage for Non-Residential accounts by the year 2040.

Exhibit 7-4
2040 Savings Goals by Customer Category

Customer Category	**CPA 1**	**CPA 2**	**CPA 3**
Single Family	6%	10%	14%
Multi Family	5%	9%	13%
Commercial & Light Industrial	5%	9%	13%
Large Turf	7%	12%	18%
Industrial	2.5%	4%	6%
District-Wide Reduction	**5%**	**9%**	**12%**

"Will conservation components be applied to the TWSA and to the RWSA?

CFG Comment 11/28/94

"Will conservation components be applied among all customer categories?"

CFG Comment 4/12/95

Coordination with Wholesale Customers. The success of CPA 1 will depend on cooperation between CCWD and its wholesale customers, with communication between parties essential. The more assistance customers provide, the easier it will be to implement CPA 1 outside the Treated Water Service Area. CCWD has already contacted all wholesale customers to discuss current conservation efforts. Upon approval of CPA 1 by the District's Board of Directors, CCWD's Conservation Office will develop a conservation master plan with input from wholesale customers. The District will then present implementation details and identify potential opportunities for cooperation or assistance through potential joint-funding of programs with wholesale customers. This will be addressed in FY97 through the development of the Water Conservation Master Plan, which covers coordination with raw water customers, accounting and data management.

Monitoring and Tracking Savings. To evaluate the cost-effectiveness of an individual conservation measure, CPA 1, and the Preferred Alternative overall, the District must estimate how much water is saved under conservation efforts. Estimating savings for individual conservation measures can be difficult, with more accuracy attributed to hardware driven programs. Therefore, early tracking to compare actual and projected savings is a necessity. Also, the District's conservation program should be flexible to respond to changing markets and technologies, particularly since some measures may prove more successful than others. Funding should be allocated to maximize water savings while ensuring that conservation assistance is offered to all customer categories. Monitoring and evaluation of conservation savings and customer demand through program record-keeping practices should be an ongoing process in the near-term Action Plan.

Developing Water Transfers

The new components within the Preferred Alternative should integrate with existing CVP supplies to meet projected demands. Conservation will assist the District in reducing future demands. Transfers will be used to bridge the gap between future supplies and projected demands. In the near-term, water transfers should assist the District in meeting demands during a drought, and meshing with the reduction in CVP supplies over the 10-year renewal window for CVP supplies (2000-2010).

The approach to developing a transfer should emphasize long-term reliability of supply, as well as operational and institutional flexibility. The negotiating strategy for any future transfer will need to consider the District's near-term needs regarding regulatory restricted and drought years, the future impacts of any CVP reductions to the District's existing entitlement, the degree of projected growth, and the expected success of short-term drought management. The evaluation of future transfers must also consider the potential benefits of in-county transfers as opposed to those outside of the county, as well as the Watershed Protection Act, Area of Origin and other related issues.

The initial steps which need to be taken by the District, prior to implementation of a water transfer, include: 1) the need to resolve outstanding issues regarding the Delta Protection Act; 2) a determination of the most favorable timing for CVPIA renewal; 3) development of a timeline integrating the need for near-term drought supplies of at least 35 TAF to be phased into a normal year requirement of an additional 20 to 40 TAF over the years 2000-2010, dependent upon the renewal of the District's contract; and 4) the development of a negotiation strategy which sets priorities for the District in terms of the phasing of water from dry year only to every year transfer needs, seasonal scheduling requirements, preferred financing methods, and a preferred cost range based on recent market prices.

Regulatory Restrictions. As the District's recently amended CVP contract sets forth, the District can expect to receive the greater of 75% of the contract entitlement, or 85% of historical use. In the near-term this means 146,000 ac-ft which is adequate for current needs; however, in the longer-term, this figure could be increased to approximately 158,000 ac-ft but historical demands will have increased to 198,000 ac-ft by 2010, thus posing a deficit of 40,000 ac-ft (USBR has indicated its desire to drop this type of shortage designation in the future). Future transfers will need to be flexible to compensate for the increased shortage which may occur in such regulatory restricted years.

Droughts. In a drought, the Bureau can reduce the District's CVP water to not less than 75% of the contract entitlement or 85% of historical use, whichever is less. Under severe drought conditions, the CVP supply can drop to as little as 75% of historical use. In the near-term 75% of historical use would represent as little as 106,000 ac-ft, as historical use is based on an average of the last three years unaffected by shortage. However, this figure could be reduced in the next few years to less than 100,000 ac-ft because of reduced water use recently experienced by the District. Historical use will change throughout the study period. The calculation of historical use includes CVP supplies put to beneficial use in the District, as well as diversions by Gaylord Container, the City of Antioch and CCWD at Mallard Slough, and is adjusted for growth in the Service Area.

CVPIA Reduction. For the purposes of this planning study, a 15% cutback in the CVP
7-6 contract was assumed based on the CVPIA, sometime between the year 2000 (when the District may renew its contract) and the year 2010 (when the contract expires). Although 15% has been assumed for planning purposes based on equal cutbacks among all CVP contractors, there is potential that the cutback could be more or less, depending on the outcome of the CVPIA. If the cutback were up to 20%, the District could lose an additional 10,000 ac-ft annually.

Because of the wide window for negotiation and the variables concerning eventual cutbacks, it is imperative that any future water transfer be flexible. Ideally, planning for a drought year transfer should grow into augmenting supplies in every year, as the CVP entitlement is reduced. This could occur in a variety of ways (such as purchasing water rights and implementing a banking program, or reselling water not needed in wet and normal years for the short-term) until the District grows into the supply and can use the water in all years. During that growth period, additional strategies could be phased in to address the ongoing drought supply problem.

Contingencies (Balancing with Drought Management). The District uses shortage planning to anticipate drought conditions and prepare for impacts that may occur (e.g., supply shortages, economic impacts on the community and reduced revenue). As CPA 1 is implemented throughout the District and greater coverage is achieved, the drought contingency plan required as part of the Urban Water Management Plan submitted every five years will need to be incorporated into the overall update of the FWSS.

During drought years, savings attributed to conservation will reduce opportunities to meet demand through short-term drought management programs. The expectations of such programs will therefore need to be reviewed in coordination with the District's other ongoing programs. Water transfers may be a more reliable solution to address such shortages in both the short and long term, as increased efficiencies within all customer use categories will reduce opportunities to achieve significant savings during drought years.

The rate impact analysis shown in Chapter 6 indicates that differences in present worth cost of the magnitude shown here, have little effect on rates. Some have much greater indirect costs; these indirect costs become the driving force.

Five contingency scenarios have been tested to determine the relationship in costs between the use of short-term drought management programs and spot transfers to meet reduced supplies during a drought. Two scenarios address the potential for a drought shortage of 15% within the District (as a percentage of gross demand), while the other three scenarios address the potential for a shortage of 25%. The scenarios examined were as follows:

CVP Drought Shortage	Water Transfer	Drought Management Program	Present Worth Cost
15%	15%	0%	$310 M.
15%	7.5%	7.5%	$280 M.
25%	15%	10%	$304 M.
25%	7.5%	17.5%	$272 M.
25%	25%	0%	$351 M.

It is important to realize the indirect impacts of drought management.

In each of the scenarios, water transfers would be used to make up the shortage during a drought in different quantities, depending on the level of the drought management program. In examining a 15% supply reduction, present worth costs decrease from $310 million to $280 million, as you move from a 0% to 7.5% short-term drought management program. In examining a potential 25% supply reduction, present worth costs decrease from $351 million to $272 million, as you move from a 0% to 17.5% drought management program. Although the earlier present worth analysis identified nominal increases in rates for present worth costs of the magnitude discussed in Chapter 6, some have much greater impact on indirect costs; these indirect costs become the driving force. While the pursuit of higher levels of drought management would reduce slightly the impact on rates due to the reduced need for water transfers, there would be a corresponding increase in indirect impacts.

Based on this analysis, it was concluded that the District should pursue a water transfer of at least 15% to minimize the potential risk of experiencing the need to implement a drought management program of 17.5% or greater during a drought. This approach would minimize cost, while maintaining an important degree of reliability. At the same time, this would leave open the possibility for using an increased drought management program should the District find it necessary due to transfers either being found unreliable or unavailable during a drought.

In addition, there are other options in dealing with short-term supply reductions over the long term. A rate analysis was completed examining four types of purchase scenarios for long-term transfers to address supply reductions which are discussed in the rate analysis section at the end of this chapter.

In-County vs. Out-of-County Transfers. In-County transfers may offer some operational and institutional benefits over transfers from outside the County. Issues to examine prior to negotiation of any final transfer include potential benefits of increased flows, carriage water or environmental water charges, area of origin issues, season and schedule of transfer flows, wheeling charges, potential third-party impacts, the necessity for environmental documentation, and any existing relationships with the transfer agency (ECCID for example). The current contract between ECCID and CCWD provides for delivery of up to 21,000 ac-ft annually by CCWD for M&I purposes within ECCID.

CCWD could explore the transfer of a portion of that water to its service area. However, such a transfer might be subject to challenge by other water users if it does not involve water that has some history of use.

Further study is required to assess the possibility of transferring water to CCWD from other lands within the Delta. Preliminary review by the District's legal counsel concluded that such a transfer might overcome some assertions of injury by other lawful users of water (particularly other Delta diverters) because the entire transaction could be within the Delta or adjacent areas. Such a transfer would be based on the transferor's ability to forego some of its consumptive use of water within the Delta, although a transferor outside the statutory Delta might also qualify.

Watershed Protection Act and Other Related Issues. State statutes provide that the counties and watersheds of origin, in particular the Delta, are entitled to water rights or water supplies adequate to meet their beneficial needs as a priority against exports from the area of origin. The Watershed Protection Act, enacted in 1933, gives priority to watersheds of origin and immediately adjacent areas that can be conveniently supplied (Water Code Sec.§11460). Because of the Delta Protection Act's (1959) integration with the Watershed Protection Act, the District can assert that the protective statutes provide assistance for the District's entire service area, based on adjacency and system connections with the remainder of the District to those areas within the actual boundaries of the area of origin which are within the CCWD service area.

Another transfer alternative needing further consideration is the acquisition of additional water for shortages or growth through a contract with the CVP or the SWP, under the provisions of the Delta Protection Act. The SWP contracts exempt the watershed of origin contractors from water shortages. However, it is not clear whether a contract with the SWP would be advantageous to the District. It may be economical to obtain a contract with the SWP as a substitute for, or to supplement, CVP supplies rather than attempting to purchase supply during a drought.

Synthesis of the Approaches to Common Goals. In developing a successful water transfer for near and long term use, the District will address the above issues by maintaining adaptability to future approaches. In addition, the District must take a proactive approach to any future transfers, identifying and consulting with other legal users to ensure non-injury to those potentially affected.

The strategy for negotiating a future transfer must optimize the near-term needs of the District regarding regulatory restricted and drought years, while maintaining flexibility to increase supplies in the longer term at a point when the District's average annual demand exceeds the CVP entitlement. A banking program may eventually be key to implementing a program that integrates short-term, long-term and seasonal needs, and should be examined more closely in concert with any proposed transfer.

Implementing a Water Transfer

Implementing a water transfer is outlined in the following steps and shown in Exhibit 7-5. The District has identified a shortlist of potential transfer sources as part of the FWSS. The shortlist is composed of sources that, at present, have the greatest likelihood of providing supplemental transfer water to the District. In Exhibit 7-6, the steps required for CEQA environmental review based on the implementation of a transfer are shown.

Exhibit 7-5
Steps for Petition for Long-Term Transfer
(Water Code Sections 382 and 1735)

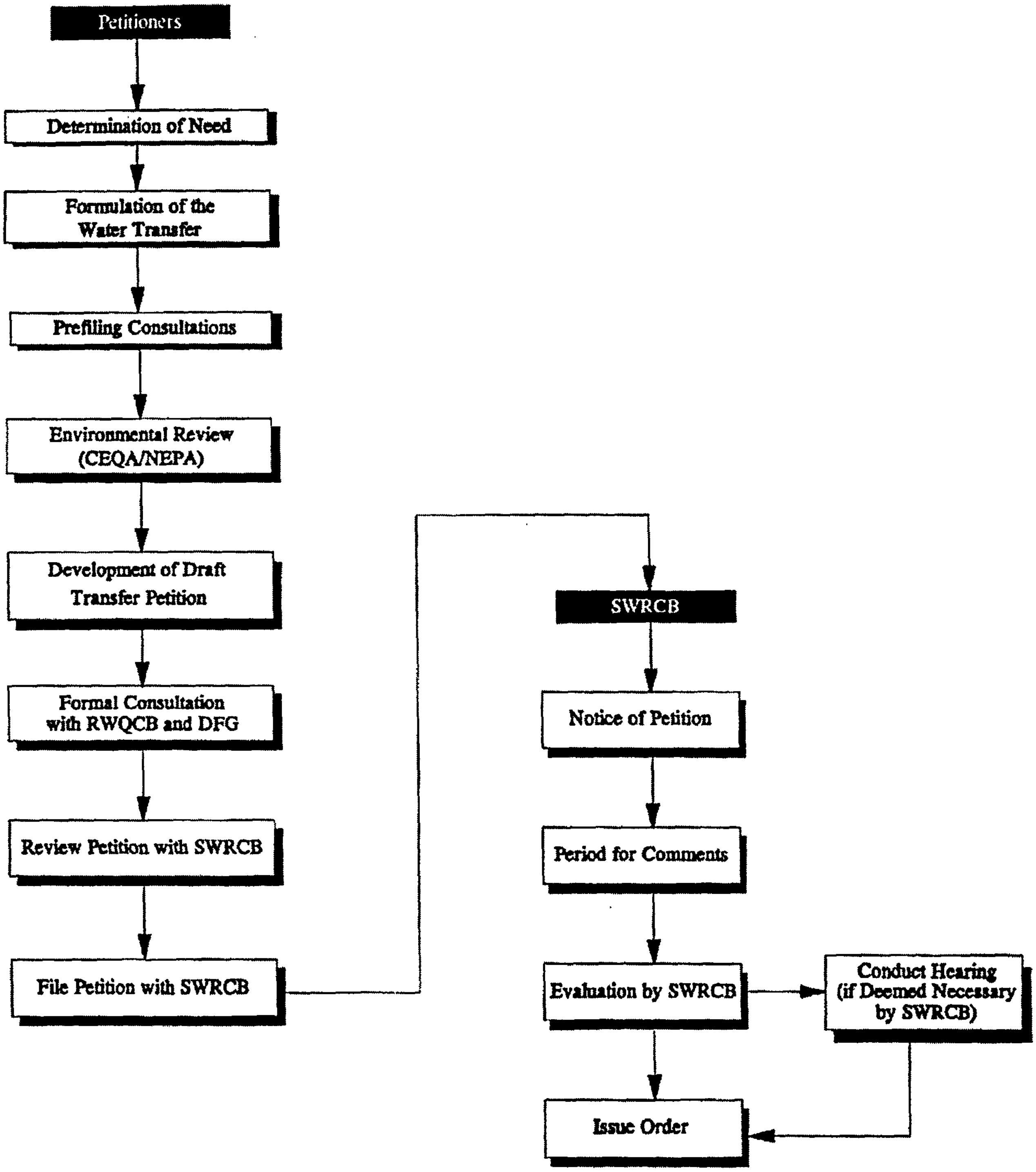
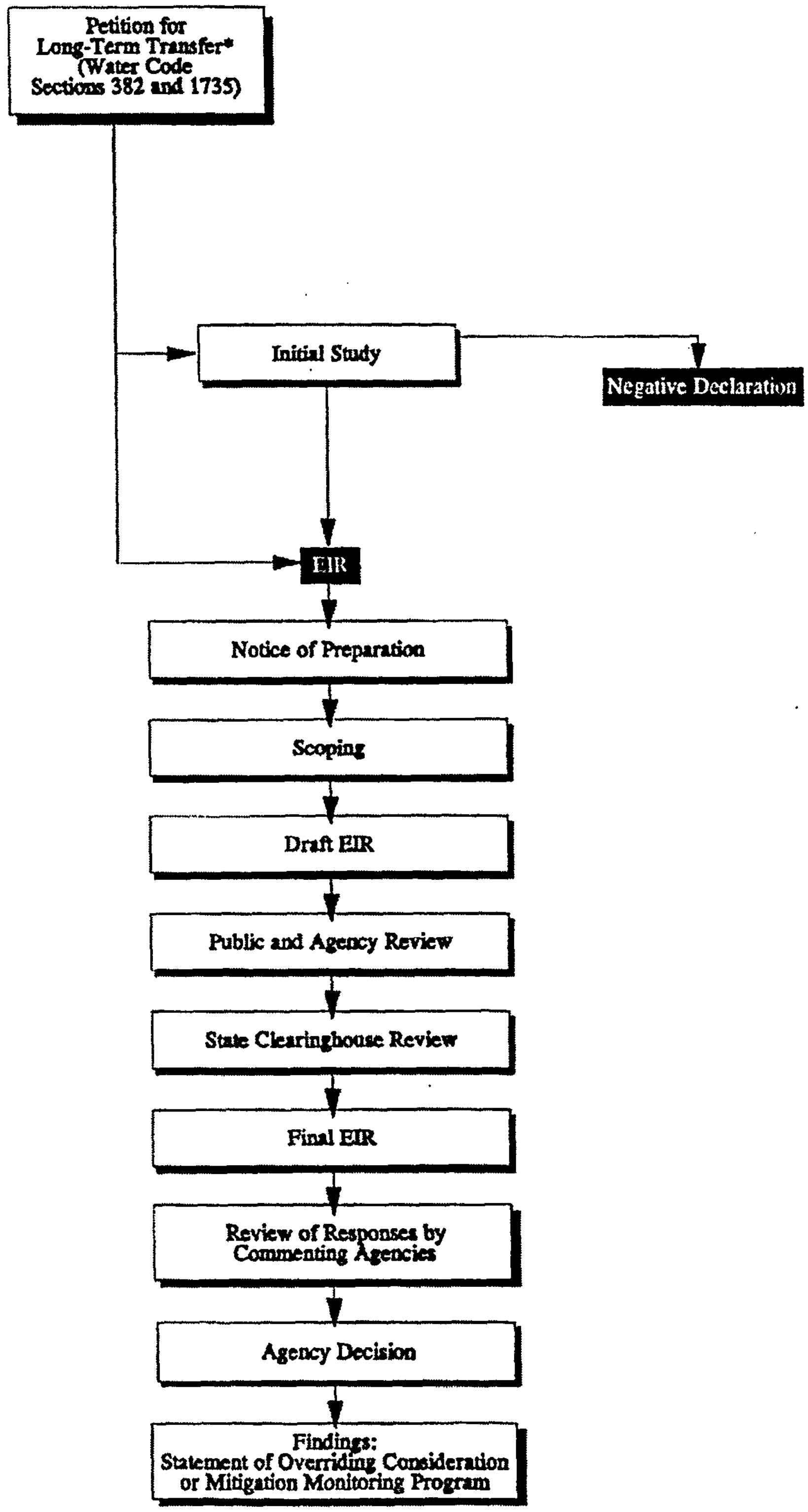


Exhibit 7-6
CEQA Environmental Review Requirements for Water Transfers



* If a lead agency can determine that an EIR will clearly be required, an Initial Study is not required (State CEQA Guidelines Section 15063[a]).

Negotiation of Transfer Terms. The negotiation of transfer terms would begin once willing sellers of favorable sources were identified (at present six have been identified). Terms to be negotiated include, but are not limited to, the following:

- Seniority or priority of water rights
- Quantity, rate and schedule of transfer flows
- Season of transfer
- Sale price
- Point of diversion
- Place of use
- Purpose of Use
- Carriage water/environmental water charges and responsibilities
- Wheeling charges (if any)
- Termination clause
- Future options on additional water
- Duration of contract and renewal conditions
- Lack of potential challenges

Depending on the transfer source, the type of water rights involved, and other particulars associated with an individual source, items to be negotiated will vary. Some details not identified within these sections have been withheld based on the influence they may have on the negotiation process, at a later date.

The negotiation of a water transfer may include the USBR for several reasons. First, the delivery schedule for the District's CVP entitlement can be varied to accommodate supplemental transfer water. Secondly, a transfer may be negotiated where the CVP, through an exchange arrangement, schedules the delivery of transfer water to the District. An example of this arrangement is provided below.

In the case of the District negotiating a transfer with an agricultural district, the CVP may be included in the negotiations to re-regulate the delivery of water to the District. Agricultural districts typically have access to water, either through contractual arrangements or water rights, during the irrigation season (June through September). Through an exchange arrangement with the CVP, the water could be released on a schedule acceptable to the transferring district, the water would remain in the Delta as a portion of the CVP's contribution to Delta outflow, and the CVP would provide an equal amount of water to the District at a different time. The CVP's delivery of transfer water to the District would probably take place on a shorter time period, perhaps a single month.

During the negotiation phase, the District should consult with regulatory agencies and potentially affected parties; many of the agencies involved in approving transfers have suggested early consultation to help ensure success.

Prefiling Consultations. Prior to filing a petition with the State Water Resources Control Board, both the transferring and receiving agencies would initiate prefiling consultation meetings. These consultation meetings would be held with intermediary agencies who facilitate transfers through negotiations, exchanges, banking and conveyance facilities, as well as agencies responsible for enforcement of State and Federal laws. Various third party interests might also be consulted at such time, including downstream water users, local communities, and environmental and conservation special interest groups and any others affected by the transfer. These consultations could be accomplished through individual meetings and public meetings. Relevant agencies include:

State Agencies

State Water Resources Control Board
California Department of Water Resources
California Department of Fish and Game
Regional Water Quality Control Board
California Department of Health Services

Federal Agencies

U.S. Bureau of Reclamation
National Marine Fisheries Service
U.S. Fish and Wildlife Service

Other Parties

CALFED Coordination Group
Other Legal Users of Water
Environmental and Conservation Special Interest Groups

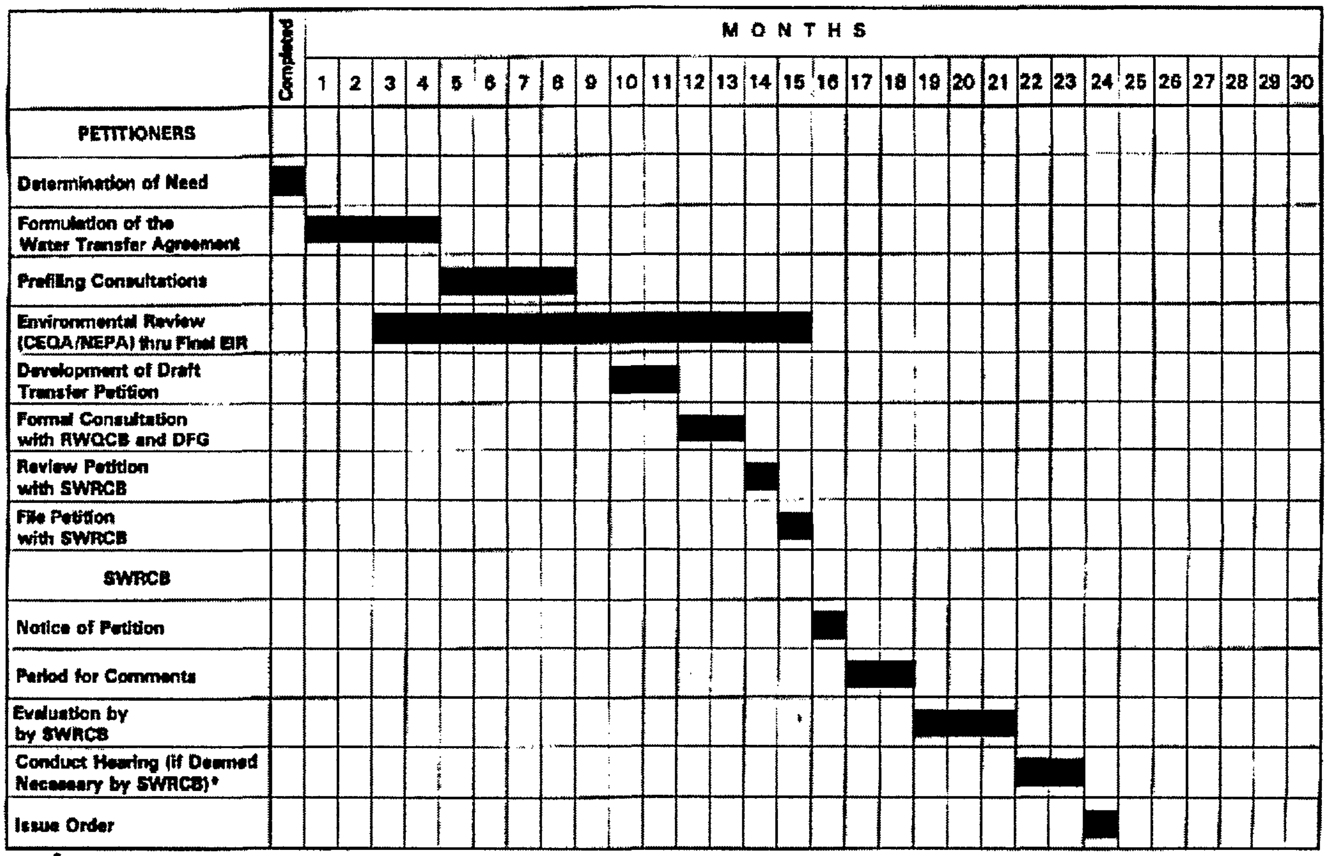
Environmental Review. It is anticipated that the District will be preparing a Programmatic EIR that encompasses results of the FWSS. This EIR would also include a review of impacts associated with transfers to the District that would occur in the District's service area, at the intakes and among the conveyance facilities of the District, and within the Delta. The assessment, however, would not cover transfer impacts upstream of the Delta; such impacts would be addressed in a separate environmental document. The following section covers the regulatory issues that need to be addressed in both the District's Programmatic EIR and the environmental assessment for upstream impacts.

7-12 *California Environmental Quality Act.* The California Environmental Quality Act requires that State and local agencies prepare an environmental impact report before approving or carrying out a discretionary project that may significantly impact environmental quality. Under CEQA, the lead agency is designated to prepare an initial study to determine whether or not the project would have a significant environmental impact. The initial study would determine whether a negative declaration can be prepared showing that the proposed action alone, or with incorporated mitigation, would not cause significant environmental impacts; otherwise, the lead agency is required to prepare an EIR. For most water transfers subject to CEQA, a transferee or transferor will serve as the lead agency for CEQA compliance, and the SWRCB will serve as a responsible agency.

Long-term transfers are subject to the normal CEQA process. For long-term transfers affecting the Delta, an EIR would likely be required by the SWRCB. Major CEQA issues of concern in the Delta that need to be addressed in an EIR include potential short-term, long-term, direct and indirect effects on Delta exports and diversions, Delta hydrodynamics and water quality, fisheries resources, and vegetation and wildlife resources. Issues of concern upstream of the Delta include potential short-term, long-term, direct, and indirect effects on instream flows, instream habitat, water quality, water temperature, fishery production, and terrestrial and riparian vegetation and wildlife and community impacts.

Exhibits 7-7 and 7-8 show estimated timelines for petitioning for a long-term transfer and meeting environmental review requirements. Compliance with environmental statutes and regulations in addition to CEQA may be required, including the following:

Exhibit 7-7
Timeline for Petition for Long-Term Transfer



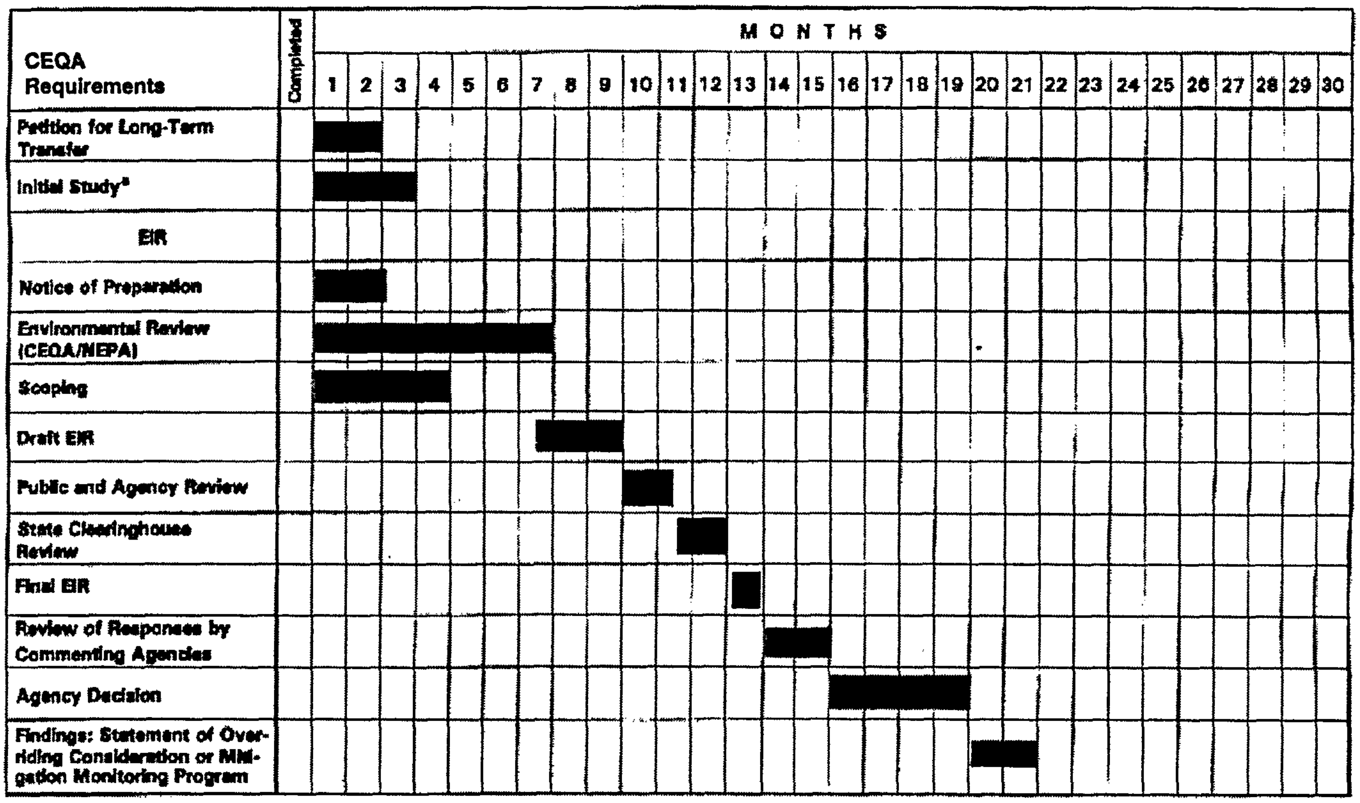
* The time required to conduct hearings is highly variable and would determine the time at which the SWRCB would issue an order approving the proposed transfer.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) is triggered if a water transfer requires a Federal agency action. If the proposed water transfer can be conducted within the CVP operational boundaries contained in USBR's Long-Term Central Valley Project Operations Criteria and Plan (OCAP), then no Federal discretionary action is needed and NEPA does not apply. If NEPA is triggered, an environmental assessment (EA) or environmental impact statement (EIS) would need to be prepared, with USBR serving as the lead agency. NEPA compliance may be performed jointly with CEQA compliance.

Federal Endangered Species Act. Section 7 of the Federal Endangered Species Act of 1973, as amended, requires Federal agencies, such as the USBR in consultation with the NMFS and USFWS, to ensure that their actions do not jeopardize the continued existence or result in the destruction or adverse modification of critical habitat of species listed under the ESA. Federally listed species that may be affected by water transfers to the District are winter-run chinook salmon and delta smelt.

California Endangered Species Act. The California Endangered Species Act (CESA) requires any State agency considered a lead agency in the CEQA process to consult formally with the California Department of Fish and Game (CDFG) when a proposed project may affect State-listed endangered or threatened species. State-listed species potentially affected by water transfers to the District also include winter-run chinook

Exhibit 7-8
Timeline for CEQA Environmental Review Requirements for Water Transfers



* If a lead agency can determine that an EIR will clearly be required, an Initial Study is not required (State CEQA Guidelines Setion 15063[a]).

salmon and delta smelt. The provisions of CESA and ESA will often be activated simultaneously.

Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act requires Federal agencies to consult with the NMFS, USFWS, and State fish and game agencies before undertaking or approving projects that control or modify surface water. This consultation is intended to promote the conservation of fish and wildlife resources by preventing their loss or damage, and to develop and improve fish and wildlife resources in connection with water projects.

Public Trust Doctrine. Under the Public Trust Doctrine, certain natural resources are the property of all. Traditionally, the public trust doctrine has been held to protect the public trust in navigation, commerce, and fishing in navigable waters. The SWRCB's decisions regarding all water transfers are subject to the common law public trust doctrine.

Development of Draft Transfer Petition. After negotiating an agreement with the transferring agency and conducting pre-filing consultations with the appropriate agencies, a draft transfer petition can be developed. The draft petition would include the statutory authority, identification of source, and change in point of diversion or place and purpose of use, quantity and rate of flow, period of transfer and completion of standard

SWRCB forms. Once the draft petition is completed, it is reviewed by the SWRCB. The preparation of the draft petition is anticipated to take one to two months.

Formal Consultation. Prior to submitting a petition with the SWRCB, the District will need to consult with the appropriate Regional Water Quality Control Board (RWQCB) and CDFG regarding the effects of the proposed change on water quality and on fish, wildlife, and other instream beneficial uses, respectively. Under Section 801 of the California Code of Regulations, Title 23, the notification or petition of the proposed change shall state what comments were received from the appropriate RWQCB and CDFG in response to the request for consultation.

After the completion of consultations and preparation of a final petition, the SWRCB would be consulted for review of the transfer petition. The review process reveals any additional information and analyses that need to accompany the formal filing of the transfer petition. Additional information potentially required by the SWRCB includes analyses of operations with and without the transfer, environmental analyses of impacts of the transfer, and analyses of impacts on legal water users. The necessary filing fees are submitted at this time.

Approval of a long-term water transfer must be made by the SWRCB according to the following findings. The change must be made without: (1) injuring any legal user of the water; (2) unreasonably affecting fish, wildlife or other instream beneficial uses; and (3) unreasonably affecting the overall economy of the area from which the water is being transferred.

SWRCB Approval Process. The approval process for a transfer submitted to the SWRCB includes the following steps: file petition, notice of petition, period for comments, evaluation by SWRCB, the potential for a hearing if deemed necessary by SWRCB, and the issuance of an order. The length of the approval process varies widely depending on the requirement to conduct a hearing, but is estimated at approximately 8 to 10 months.

In-District Facility Requirements. Based on the amount of transfer water currently required both during the short term, during drought years, and in the long term, no additional facilities would be required to facilitate the transfer of additional water to the District's intake facilities. Such transfers could be taken through either Rock Slough or the District's new intake at Old River, both of which would be screened diversions. Facilities that may need to be increased over time include the treatment and conveyance capacities of the District's existing system; these are being addressed in other studies and District activities.

Drought Contingency Plan for the Short-term

The District includes a plan within its Urban Water Management Plan to address short-term or emergency water management practices required during a drought or other water shortage condition. The shortage plan includes six steps:

1) Forecast Supply Situation in Relation to Demand
2) Assess Drought Mitigation Options
3) Establish Demand Reduction Plan Stage
4) Select Allocation Methods
5) Adopt the Drought Plan
6) Monitor Results and Adjust Drought Status

Step 3 refers to the demand reduction stages within the District's plan, as shown in Exhibit 7-9.

Exhibit 7-9
Demand Reduction Plan

Demand Reduction	Stage	Type	Total Reduction Goal	Single Family Goal
Voluntary Conservation	I	voluntary	5%	5%
Water Alert	II	voluntary	15%	15%
Water Emergency	III	mandatory	25%	30%
Water Crisis	IV	mandatory	40%	50%

Stages I and II would be easily attainable with the Preferred Alternative including implementation of CPA 1. In the most recent drought, the District experienced reductions of 26 to 30% from a combination of voluntary cutbacks and rate increases in 1991, therefore, Stages 1 and 2 would likely be easily reached through voluntary measures. Stage III of the Drought Contingency Plan would be more difficult to attain but is included in the Preferred Alternative through spot transfer purchases, transfer options or additional demand management. Stage IV addresses an emergency situation. Definitive plans for achieving the four stages of the Drought Contingency Plan should be coordinated with future updates of the FWSS.

In a short-term drought situation, it may seem reasonable to implement a drought management program to cut demand by the amount of supply cutback. However, the problem with this solution is that the severity and duration of a drought cannot be predicted, and in extreme cases, customers would be subject to restrictions and conditions that the District may deem unacceptable. In addition, a drought management program is not a zero-cost solution due to the implementation costs and the necessarily higher water rates required to pay for the fixed costs of water production, treatment and distribution at lower volumes.

As the District's conservation program becomes more established and greater savings are achieved by customers, it will be necessary to reexamine near-term and long-term supplies in relationship to the stated demand reduction goals of the District's drought contingency program. The District's emphasis in maintaining a viable drought contingency plan must be to diligently secure spot transfers, and ensure the reliability of long-term supplies so the District can avoid a shortfall beyond what is achievable through voluntary means. As long term conservation programs achieve greater coverage, the ability for the District to implement short term drought management programs in response to supply cutbacks during a drought diminishes (see Technical Appendix C, Demand Hardening).

Capital and O&M Costs

Capital and O&M costs are an important consideration within the Implementation Plan. The Preferred Alternative must maintain consistency with the District's CIP and rate revenue stream. Steps to be taken include ensuring that the capital and O&M costs for the components within the Preferred Alternative are consistent with the placeholders included within the CIP for the FWSS.

All components of the near-term Action Plan have been accounted for in the District's current 10-Year CIP. The framework for the CIP includes a description of programs and level of funding, prioritization criteria, and key assumptions used in developing the CIP. The CIP includes estimated expenditures for District-wide O&M activities, as well as completion of the capital projects.

Life-cycle costs include both capital and operation and maintenance (O&M) expenditures. The capital portion of CPA 1 includes the ULFT program for $3.76 million over the next 10 years or $376,000 annually. O&M costs for CPA 1 have been estimated at $1.4 million annually by the year 2000, increasing to $1.6 million by the year 2020. These costs are driven primarily by staffing needs and the ULFT program. Costs are in 1996 dollars and have not been escalated, discounted or financed. The accuracy of these costs is consistent with estimates in the District's CIP, which are appropriate for planning-level studies only. Costs are for the long-term conservation program only and do not include costs related to short-term drought management programs.

The 1997-2006 CIP includes $20 million (+50/-30%) as a placeholder for future water supply projects, including water transfers to implement the FWSS. Costs for a surface water transfer were based on $50 to $175 per ac-ft annually for a long term transfer including $40 to $50 in pumping and in-Delta restoration charges and $125 to $300 per ac-ft annually for spot transfers required in drought years (high end was used in the rate and present worth analysis; the range reflects potential prices). The entire cost of purchased water rights to meet drought year demands is paid for by ongoing water rates including raw water rates for future facilities. For future water transfers required to meet increased demand, the cost of water transfers could be assigned to the rate for raw water facilities.

Annual Costs. Near-term annual costs for the Preferred Alternative would include costs of CVP water, implementation of CPA 1, and purchase and delivery of water when needed (particularly drought years). Annual costs for CVP water will remain within the contract unit price (currently $56 per ac-ft), and the total will vary based on the quantity of water pumped at Rock Slough. Costs and staffing for CPA 1 will increase from the current expenditure of $1.04 million to $1.38 million annually in the year 2000. Annual costs for purchase and implementation of a long-term water transfer depend on negotiation of a final contract, but a placeholder of $20 million has been included within the 10-year CIP.

2-year Budget. The District now uses a 2-year budget cycle. The current amount budgeted for the implementation of CPA 1 for FY96-97 is $778,000, increasing in FY97-98 to $832,000. This budget is consistent with the escalated annual O&M costs for the Preferred Alternative. The amount requested in the budget for implementing a water transfer over FY97 and FY98 is $2 million including staffing needs, which is consistent with the estimated costs projected for obtaining a water transfer to meet near-term drought needs.

Capital Improvement Program (CIP). The 1997-2006 CIP is composed of nine programs containing 62 separate capital projects with a total estimated cost of $346 million, with an added $87 million for the Los Vaqueros Project. The CIP includes a variety of capital improvements that will be required to maintain and enhance the ability of the District to meet the needs of its present and future customers.

The current CIP includes $376,000 annually for the ULFT program over the next 10 years. In some cases, placeholders for capital projects required to implement FWSS recommendations were included in the CIP because detailed project information was unavailable. For example, the project details and actual costs associated with water transfers will not be known until specific contracts are negotiated. However, the costs for obtaining water transfers under the Preferred Alternative are estimated to range between $10 million and $23 million through the year 2010. The 1997-2006 CIP has a placeholder of $20 million over the next 10 years.

Rate Analysis. The methodology for rate analysis was first to identify O&M costs, debt service on borrowed capital, and capital programs funded directly from revenues; offset these expenditures with non-rate revenues including raw water rates for new facilities, interest earnings on fund balances, property taxes, and revenues; and finally derive the net revenue requirements funded from water rate revenues. Results of the rate analysis indicate that implementation of the Preferred Alternative would not result in additional impacts on rates and is consistent with the current CIP. The largest FWSS expenditure is to purchase, or transfer, water rights. Since these costs are already built into the 10-year CIP, the Preferred Alternative does not have a significant impact on current water rates.

Rate analysis indicates that implementation of the Preferred Alternative would not result in additional impacts on rates because the current rate structure includes a placeholder of 20 million dollars for the next 10 years for the purchase or transfer of water rights.

Consideration for Water Purchases. The District could choose to pursue a water transfer or combination of transfers through any variety of financing methods. In each method studied, it was assumed that a drought would occur once every seven years. The analysis also recognized that drought conditions can occur anytime and can last much longer than one year. Four types of purchase scenarios for water transfers were studied in
7-18 relation to the discussion of the Preferred Alternative:

- **Method 1:** Purchase water rights *in perpetuity* at the current market price of $1,000/ac-ft (one time fee); water would be sold in wet and normal years for $50/ac-ft/yr.
- **Method 2:** Purchase water for only *1 year in 7* at an estimated spot market price of *$300*/ac-ft/yr plus inflation. (Estimates of $175 and $300 were used here for methods 2,3 and 4. Prices include approximately $40-$50 in O&M, pumping and in-Delta restoration charges.)
- **Method 3:** Purchase water rights for *all years* at an assumed transfer price of *$175*/ac-ft/yr to meet an 8% cutback, and supplement with a *7% drought management program*; water would be sold in wet and normal years for $50/ac-ft.
- **Method 4:** Purchase water rights for *all years* at an assumed (upper end) price of *$175*/ac-ft/yr excluding pumping costs; water would be sold in wet and normal years for $50/ac-ft/yr.

The most cost-effective method would be the purchase of a water rights entitlement in which all drought water demand is purchased up-front in perpetuity (Method 1); this would ensure the availability of water if and when a drought occurs. The drought cutback was estimated to be approximately 25,000 ac-ft. Perpetual water rights for the maximum drought demand of 25,000 ac-ft per year might be purchased for $1,000 per ac-ft (one-time fee), based on the estimated current market price. Water not needed for drought conditions would be sold for an estimated $50 per ac-ft. Exhibit 7-10 shows that this approach resulted in the lowest net present value of the four water methods investigated, and a negative cumulative investment by 2040 because the favorable purchase cost is up-front and the unneeded water sales in non-drought years continue to reduce the cumulative investment.

Exhibit 7-10
Comparison of Total Investment for Purchase Options
(Net Present Value in millions of $)

Purchase Option	2010	2020	2030	2040
Method 1	22.7	15.2	3.0	-7.9[1]
Method 2	10.2	25.2	33.3	49.7
Method 3	12.1	26.0	39.9	56.1
Method 4	22.7	47.0	69.8	96.0

[1]Negative net present value reflects a negative cumulative investment resulting from unneeded water sales in non-drought years.

LONG-TERM IMPLEMENTATION SCHEDULE

The long term Implementation Schedule is based on a number of considerations including the anticipated future reduction of the District's entitlement and outcome of the CVPIA, and has been developed as a framework in which to consider key questions and issues during updates of the FWSS.

CVPIA Reductions

Under the District's current CVP contract, the Bureau provides up to 195,000 acre-feet annually. The 1994 Amendatory Contract is effective through December 31, 2010. However, the Bureau may not be able to provide this full supply during drought and regulatory restricted years. In addition, the CVP's ability to provide water supplies to CCWD is greatly affected by regulatory issues and water conditions in the Sacramento-San Joaquin Delta and upstream. Required Delta flows are expected to increase as a result of the CVPIA, which would decrease supplies available to CVP contractors. Based on the CVPIA, the District's entitlement could be reduced by 15%, or almost 30,000 ac-ft, upon renewal of their CVP contract. (Renewal would occur after release of the CVP Program EIS, but no later than 2010). The 15% cutback assumes that all CVP contractors are reduced by the same percentage. In such a case, future maximum normal year and drought year deliveries could be 166,000 acre-feet and 140,000 acre-feet, respectively.

Near-term to Long-term Transition

Studies by the U.S. Bureau of Reclamation for their PEIS confirm that implementation of the CVPIA creates a significant impact on CVP urban water supplies (as well as others) that would result in more frequent shortages. In essence, the CVP yield is reduced and contractors can expect lower reliability on a regular basis; this means there is a *de facto* supply reduction whether or not the contract is reduced. This requires consideration of a transition plan from near-term to long-term.

The near-term Action Plan calls for the District to pursue water supplies sufficient to meet at least 15% of demand for shortage periods. Acquisition of this amount will be sufficient to meet most shortage needs, whether from drought or CVPIA reductions, through 2005, based on Service Area C demands (the water would not be needed in every year, because of other District supplies available in wet years). After 2005, river diversions are not likely to be sufficient when coupled with the CVPIA reduction and water transfers acquired for shortages. Consequently, it is in 2005 that the District should plan to start acquiring the water needed to make up for any CVPIA reductions, with all water acquired by 2010. The amount to be acquired and the rate at which it should be acquired will be reassessed in the next update of this plan, currently scheduled in 2002. The reassessment should consider: 1) actual demands, 2) success of conservation programs, 3) the final assessment of CVP yield and 4) the final or anticipated terms of the CVP contract.

CVP Contract Renewal and Other Contract Possibilities

The CVP contract renewal period encompasses a large 10-year window of time. The District could wait until the year 2010 to renegotiate the contract, based on the quantity of water that needs to be replaced; the projected water demand for the year 2010 for Service Area C is 198,000 acre-feet. However, it may be advantageous for the District to negotiate earlier with the Bureau as discussed in the near term Action Plan. The decision will be weighed based on the actual reduced amount of water available under a new contract, and the costs ($20 per ac-ft, 1996), which would be attached to the District's contract for failure to renew early.

CCWD has agreed with ECCID to use up to 21,000 ac-ft/yr of ECCID water supply to service M&I demand within ECCID, portions of which are now, or potentially may be, within the CCWD Service Area. ECCID's water right is not subject to regulatory deficiencies and, therefore, neither is the portion of water transferred to CCWD. The transferred water is available in three blocks over a 20-year period. The first block of 8,000 ac-ft/yr is currently available to the District; the second block of 7,000 ac-ft will be made available to CCWD on January 1, 2000; and the third of 6,000 ac-ft in 2010. On October 19, 1995, CCWD entered into an agreement with the City of Brentwood that provides for the transfer of 7,000 ac-ft/yr to Brentwood for its future water needs. The City has the option to purchase this quantity from the District by 1997. If the City exercises its full option of 7,000 ac-ft, the remaining 14,000 ac-ft would be available for other uses, including a potential transfer to the CCWD service area.

Updating the FWSS

The Future Water Supply Study is designed to be a flexible, "living" planning document, with periodic reviews and updates to respond to future water needs and changing conditions. Key questions and issues to consider during future updates of the FWSS include:

- Comparing actual and projected demand;
- Determining the success of conservation efforts;
- Evaluating whether additional conservation or reclamation savings could be achieved, and if these savings could postpone the need for additional water supplies;
- Determining whether additional conservation or reclamation would be cost-effective;
- Reviewing the availability and reliability of new water supplies; and
- Evaluating market availability and the success of any new technologies.

Future updates could be based on more definitive estimates of available supplies in the short term, once CVPIA and the CALFED Program Alternative are closer to implementation.

Growth. Growth is expected to continue within the District, primarily due to residential development in the East County. Demand in Service Area Alternative C is projected to increase approximately 40% from 1990 to the year 2020. Monitoring such growth during updates to the FWSS will be important to phasing in additional projects and programs. If growth occurs at a slower rate than projected, additional supplies may be delayed.

Potential to Implement CPA 2. The District's demand management efforts, both long-term conservation and short-term drought reductions, have been very successful to date. District customers significantly reduced their use during the recent drought, and lingering effects have resulted in current use remaining below anticipated levels. Consequently, it is possible that District customers will achieve CPA 2 savings levels without formally instituting CPA 2. Therefore, the Preferred Alternative includes implementation of CPA 1 in the short-term Action Plan, with monitoring of customer demand and conservation savings. If during FWSS updates the District determines that demand is higher than anticipated and CPA 1 is not as successful as anticipated, CCWD may choose to formally implement CPA 2. The District will want to evaluate whether additional savings could be achieved, whether it would be cost-effective, and if potentially it could reduce the need for expansion or development of additional facilities.

Consequently, it is possible that District customers will achieve CPA 2 savings levels without formally instituting CPA 2. Therefore, the Preferred Alternative includes implementation of CPA 1 in the near-term Action Plan, with monitoring of customer demand and conservation savings.

Reclamation. Reclamation would provide a fairly constant water supply during all seasons and water year classifications, freeing up other potable supplies for more selective use. However, the costs associated with potential projects make these alternatives unfeasible at this time. As technologies improve, these alternatives may become more feasible[1]. Also, if water transfers are more difficult to negotiate than anticipated, reclamation may prove more promising. Consequently, a review of reclamation opportunities, in terms of cost-effectiveness of projects and an updating of new technologies, should also be included in the updates to the FWSS.

Additional Water Transfer(s). Driven by supply and demand considerations, the transfer market is constantly changing. The six alternative sources identified in the short-term Action Plan are based on today's environment; six months from now this list could change. Other sources will continue to be examined and revisited prior to and during future updates of the FWSS. The District's short-term need is for drought year supplies; however, this will change as CVP entitlements are reduced between the years 2000 and 2010, and the District's need for additional supplies continues to grow.

Banking. Water banking as a component of an overall long-range plan can expand flexibility and reliability of the District's supplies. Banking is not viewed as necessary for a near-term solution, however, decision points will be noted on the implementation timeline for consideration and evaluation of a banking program in the future. As demand increases and the District purchases additional transfer water, banking will become a more practical option. It must be made clear that the Los Vaqueros Reservoir is not a banking program for the District; it was permitted for the specific purpose of improving water quality and increasing emergency storage.

An increase in banking would likely increase the cost of supplies. The District has a number of possibilities to consider in the future. Instead of purchasing supplemental water as a spot transfer, for example, another approach would be to purchase a long-term transfer or water entitlement and bank the water. The strategy would be to purchase a contracted quantity of water each year, store a portion of the water in a banking

1 Within the last couple of months, updated costs have been released for other recycling projects recently constructed (cooling towers) outside of the District which are similar to those projects studied for FWSS. Updated per ac-ft costs are lower than earlier estimates (i.e., used as the guideline within the FWSS), based on commencing operation of the project and moving into full production. The FWSS will continue to track the cost results related to such projects and will reflect adjustments in the FWSS Implementation Plan of the next update if costs are found to continue to be much lower than originally estimated once more of an operating history based on full operational status has been established.

program during wet and normal years and then take advantage of the stored water during drought years. This would increase the reliability of future supplies.

Other Supply Alternatives. As the near-term Action Plan is implemented and monitored, the District will discover that some components are more successful than others. Over the long term, there will also be changes in the regulatory environment, water supply markets, and water treatment and distribution technologies. This may result in future water needs being somewhat different than what is envisioned today. Consequently, as part of the FWSS updates, the District should continue to review other supply options which may include desalination, conjunctive use, water banking, etc. that are not currently included in the Preferred Alternative.

As new supplies are developed for the District such as additional groundwater supplies within the Service Area, they would be taken into account in future updates, as well as in the contractual arrangement for new supplies.

Drought Contingency Planning (Long-Term)

Over the long term, the District's drought contingency planning needs will evolve. Many customers prefer to maintain a stable, reliable supply which stabilizes rates. Short-term drought management measures and more stringent drought contingency measures, however, can create variability in the revenue stream due to reductions in water use. Since the District's fixed costs do not change, the result can be a rate increase depending on the amount of water use and level of contingency funding. Sizeable rate increases because of reduced sales from short-term drought management programs should be avoided.

Future updates of the District's drought contingency plan will need to reflect the success of CPA 1, the potential implementation of more aggressive conservation and reclamation programs in the future, and the cost and availability of water transfers. A successful conservation program will most likely limit opportunities for District customers to easily reduce water use during a drought. As customer water use becomes more and more efficient over the years, the District's ability to rely on customers for short-term reductions will diminish. The District will then have to rely on lifestyle changes to meet demand. Therefore planning for drought years becomes critical as the District moves into the future.

CONCLUSION

The FWSS was developed to respond to a number of interrelated planning issues that affect the District's ability to meet future water demands. The Preferred Alternative results in a near-term Action Plan and long-term Implementation Schedule aimed at providing the District an integrated approach towards responding to these issues in a reliable, cost-effective and environmentally responsible way. The Study is an important tool to assist the District in developing a framework on which to base future decision-making. Future updates of the report will be important in continuing the process, evaluating the success of the initial near-term Action Plan and refining the Implementation Schedule of anticipated actions and options, based on updated knowledge of demand and supply trends critical to the District's future.

8. References

Documents

Antioch, City of. Adopted, 1989. Antioch General Plan, 1988-2000. December 1988.

Antioch, City of. January 1992. Preliminary Utility Sizing and Budget Cost Alternatives for the Lone Tree Valley Service Area. Prepared by: McGill-Martin-Self.

Antioch, City of. January 1992. Preliminary Utility Sizing and Budget Cost Alternatives for Future Urban Area #2. Prepared by: McGill-Martin-Self.

Antioch, City of. March 1994. Residential Project Status Sheet.

Antioch, City of. August 1982. Southeast Specific Plan. Southeast Antioch Area. General Plan/Specific Plan: Antioch, California, Report 4. Prepared by: WPM Planning Team, Inc.

Antioch, City of. July 1991. Water System Master Plan Update; City of Antioch, California. Prepared by: Brown and Caldwell Consulting Engineers.

Brentwood, City of. June 8, 1993. Brentwood General Plan 1993-2010. Prepared by: The Planning Center.

Brentwood, City of. July 1994. City of Brentwood, Infrastructure Plan Reports. Element: Water Distribution System, Draft. Prepared by: Nolte Associates.

Brentwood, City of. November 1986. City of Brentwood; Report on Water Supply Study. Prepared by: Dewante and Stowell Consulting Engineers.

Brentwood, City of. October 1990. City of Brentwood Water Supply Study.

Bureau of Reclamation, Department of Interior. May 1994. Criteria for Transfers of Base Supply Water Under Sacramento River Water Right Settlement Contracts.

Bureau of Reclamation. October 5, 1992. Central Valley Project Improvement Act of 1992., P.L. 102-575; 106 Stat. 4706.

California Department of Fish and Game. 1961. Preliminary fisheries evaluation of the proposed Paskenta Dam Irrigation Project on Thomes Creek, Tehama County, California. Sacramento, CA.

California Department of Fish and Game 1987a. Office files for Yuba River. Memo dated June 11, 1987. Lawrence G. Preston - South Yuba/Brophy Irrigation Diversion Study. Region II Office, Rancho Cordova.

California Department of Fish and Game 1988. Office files for Yuba River. Memo dated Nov 18, 1988. Deborah Konnof - South Yuba/Brophy Irrigation Diversion Study. Region II Office, Rancho Cordova.

California, Department of Water Resources. August 1994. California Water Plan Update. Bulletin 160-93, Volumes 1 and 2.

California, Department of Water Resources. 1993. Sacramento/San Joaquin Delta Atlas.

California, Department of Water Resources. 1993. State Drought Water Bank, Program Environmental Impact Report.

California, Department of Water Resources. 1993. Water Transfers in California: Translating Concept into Reality.

California Urban Water Agencies. February 1992. Evaluating Urban Water Conservation Programs: A Procedures Manual. Prepared by: Planning and Management Consultants, Ltd.

California Urban Water Agencies. December 1993. Long-Term Conservation & Shortage Management Practices, Draft Report. Prepared by: Tabors Caramanis and Associates.

Central Contra Costa Sanitary District. April 1995. Recycled Water for Landscape Irrigation: Draft Zone One Business Plan.

Clayton, City of. July 17, 1985. Clayton 2000. General Plan Revision and EIR.

Clayton, City of. March 1990. Clayton Town Center Specific Plan. Prepared by: Naphtali H. Knox and Associates, Inc., Urban Planners.

Clayton, City of. May 1994. Marsh Creek Road Specific Plan. Prepared by: Brady and Associates Planners and Landscape Architects.

Concord, City of. April 14, 1994. Draft General Plan; City of Concord. Prepared for Planning Commission Consideration, April 20, 1994.

Contra Costa County. May 1993. Draft EIR for the Shell Oil Company Clean Fuels Project.

Contra Costa County. July 1994. Draft EIR for the Tosco Refining Company Clean Fuels Project.

Contra Costa County Community Development Department. September 1990. Draft EIR for the Proposed Contra Costa County General Plan.

Contra Costa County Planning Department. July 10, 1990. Bethel Island Area Specific Plan (Draft).

Contra Costa County Planning Department. January 1991. General Plan 1990-2005.

Contra Costa Water District. December 1989. Canal Facility Plan; Volumes 1 and 2. Prepared by: CH2MHill. Vol. 1 [text] Rehabilitation, O&M and Right-of-Way Elements. Vol. 2 [maps].

Contra Costa Water District. January 5, 1994. East County Water Supply Management Study: Phase I - Supply and Demand.

Contra Costa Water District. March 1990. Evaluation of Residential Water Survey Program, 1989.

Contra Costa Water District. August 1986. Final Stage 1 Environmental Impact Report/Environmental Impact Statement for the Los Vaqueros/Kellogg Project. Prepared by: Jones & Stokes Associates, Inc.

Contra Costa Water District and the U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region. September 27, 1993. Final Stage 2 Environmental Impact Report/Environmental Impact Statement for the Los Vaqueros Project.

Contra Costa Water District. October 27, 1993. Findings of Fact and Statement of Overriding Considerations for the Los Vaqueros Project Stage 2 EIR.

Contra Costa Water District. June 1993. Landscape Water Audit Evaluation. Prepared by: John Whitcomb, Ph.D.

Contra Costa Water District. Aug. 1994. Landscape Water Audit Evaluation. Prepared by: John Whitcomb, Ph.D.

Contra Costa Water District. September 12, 1991. Los Vaqueros Project: Analysis of Land Uses and Potential for Growth in Eastern Contra Costa and Alameda Counties.

Contra Costa Water District. December 1989. Los Vaqueros Project: A Water Quality and Resource Management Project, Task 16 - Evaluation of Project Configurations; Subtask 16.01, Future Water Demands. Prepared by: James M. Montgomery Engineers.

Contra Costa Water District. May 1991. Measuring the Water Reduction from Contra Costa Water District's 1989 Residential Water Audit Program. Prepared by: John Whitcomb, Ph.D.

Contra Costa Water District. April 1992. Recycled Water Program. Prepared by: Whitley, Burchett and Associates, Inc.

Contra Costa Water District. January 18, 1994. Reliability Based Seismic Design Criteria, Final Draft.

Contra Costa Water District. May 1990. Report for the Demonstration Phase of the Industrial Reclamation Project; Volume 1 - Project Report, and Volume 2 - Appendix. Prepared by: James M. Montgomery Consulting Engineers, Inc.

Contra Costa Water District. Aug. 1994. Residential Water Audit Evaluation. Prepared by: John Whitcomb, Ph.D.

Contra Costa Water District. October 1990. Technical Report for Department of Health Services Operating Permit. Prepared by: James M. Montgomery Consulting Engineers, Inc.

Contra Costa Water District. February 1995. Ten Year Capital Improvement Program for Fiscal Years 1996-2005.

Contra Costa Water District, Planning Department. August 1994. Treated Water Master Plan, Final Report.

Contra Costa Water District, Planning Department. August 6, 1993. Updated Buildout Treated and Raw Water Demand Projections, Administrative Draft.

Contra Costa Water District and Central Contra Costa Sanitary District. February 1992. Urban Landscaping Recycled Water Program Master Plan. Prepared by: Camp Dresser & McKee, Inc.

Contra Costa Water District. October 1993. Urban Recycled Water Business Plan.

Contra Costa Water District. January 1991. Urban Water Management Plan.

Contra Costa Water District. December 1995. Urban Water Management Plan.

Contra Costa Water District. January 1992. Urban Water Shortage Contingency Plan.

Contra Costa Water District. January 1995. Water Conservation Plan: Report to the United States Bureau of Reclamation on CCWD Water Conservation Program and Activities (Final).

Contra Costa Water District. July 1994. Weather Normalization Evaluation. Prepared by: John Whitcomb, Ph.D.

Contra Costa Water District and the U.S. Bureau of Reclamation, Mid-Pacific Region. August 6, 1992. Biological Assessment for Federal Threatened, Endangered, and Candidate Species for the Los Vaqueros Project. Prepared by: Jones & Stokes Associates, Inc.

Contra Costa Water District and U.S. Bureau of Reclamation, Mid-Pacific Region. March 1991. Scoping Report for the Contra Costa Water District Los Vaqueros Project Stage 2 EIR/EIS. Prepared by: Jones & Stokes Associates, Inc.

Davisson and Criss. February 7, 1994. Proposal to Evaluate the Groundwater Resources of Brentwood Using Isotopic Techniques. Lee M. Davisson, Lawrence Livermore National Laboratory and Robert E. Criss, University of California, Davis.

Davisson, Lee and Campbell, Karla. October 12, 1994. Preliminary Report on the Groundwater Isotope Study in the Brentwood Region.

3-4 Delta Diablo Sanitation District and Contra Costa Water District. 1992. City of Antioch Satellite Reclamation Facility Evaluation. Draft Report. Executive Summary; DDSD/CCWD Industrial Water Recycling Project. Prepared by: Montgomery Watson.

Delta Diablo Sanitation District and Contra Costa Water District. May 1993. Executive Summary; DDSD/CCWD Industrial Water Recycling Project. Prepared by: Montgomery Watson.

Delta Diablo Sanitation District and Contra Costa Water District. May 1993. Project Report ; DDSD/CCWD Industrial Water Recycling Project. Prepared by: Montgomery Watson.

Hall 1979, An evaluation of downstream migrant chinook salmon losses at Hallwood-Cordua Fish Screen. CDFG Anadromous Fisheries Branch Admin. Report No. 79-5.

Hallock, R.J. and F.W. Fisher. 1985. Status of winter-run chinook salmon Oncorhynchus tshawytscha, in the Sacramento River. California Department of Fish and Game, Anadromous Fisheries Branch. Sacramento, CA.

Luhdorff & Scalmanini, Consulting Engineers. January 1990. Master Plan for Water Supply and Water System Operation, Discovery Bay. Prepared for the Hoffman Company.

Luhdorff & Scalmanini, Consulting Engineers. April 1994. Regional and Local Ground-Water Conditions Discovery Bay Area, Eastern Contra Costa County.

Martinez, City of. Adopted May 6, 1987. Alhambra Hills Specific Plan. and Final Environmental Impact Report. Prepared by: Sedway Cooke.

Martinez, City of. December 1985. John Muir Parkway Specific Area Plan. Prepared by Community Development Department.

Martinez, City of. Adopted 1973. Martinez General Plan. Prepared by: Sedway Cooke.

Martinez, City of. July 1990. Martinez General Plan; 1973-1990 Amendments.

Martinez, City of. March 1988. Water Master Plan; City of Martinez. Prepared by: Brown and Caldwell Consultants.

Mills, T.J. and F. Fisher. 1994. Central Valley Anadromous Sport Fish annual run-size, harvest, and population estimates, 1967 through 1991. Third Draft. State of California, The Resources Agency, Department of Fish and Game.

National Marine Fisheries Service. 1993. Biological Opinion for the Operation of the Federal Central Valley Project and the California State Water Project. Long Beach, CA.

Oakley (Diablo) Water District. October 1991. Master Water Plan Update 1991 for Oakley Water District. Prepared by: Black & Veatch.

Oakley (Diablo) Water District. January 23, 1992. Oakley Water District Water Shortage Contingency Plan.

Oakley (Diablo) Water District. February 22, 1989. The Urban Water Management Plan of Oakley Water District.

Pittsburg, City of. September 1988. Pittsburg General Plan. Prepared by: Blayney-Dyett, Urban and Regional Planners.

Pittsburg, City of. November 1992. 1992 Update to the Urban Water Management Plan (Draft), City of Pittsburg. Prepared by: Robert Soderbery, Public Services Director, Jess Arenivar, Assistant Public Services Director, and Gloria Cannon, Consultant.

Pittsburg, City of. February 1992. Water Shortage Contingency Plan.

Pleasant Hill, City of. November 1990. General Plan.

The Resources Agency. January 1993. Draft Program Environmental Impact Report; State Drought Water Bank.

The Resources Agency. 1989. Upper Sacramento River Fisheries and Riparian Habitat Management Plan. The Resources Agency of California, Sacramento, California. 158pp.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action: California Department of Fish and Game. Sacramento, CA.

SWA Group Land Planners. October 1992. Zoning and Land Use Plan for Cowell Ranch.

U.S. Fish and Wildlife Service. 1995. Working Paper: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 2. May 9, 1995. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, CA.

U.S. Fish and Wildlife Service. 1995b. Working Paper: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 3. May 9, 1995. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, CA.

Vogel, D.A., K.R. Marine, and J.G. Smith. 1988. Fish passage action program for Red Bluff Diversion Dam. Final report on fishery investigations, executive summary. (Report No. FR1/FAO-88-19.) U.S. Fish and Wildlife Service, Fisheries Assistance Office. Red Bluff, CA.

Walnut Creek, City of. 1989. 1989 General Plan. Vision 2005: A Plan for the City of Walnut Creek.

Water Education Foundation. Updated 1993. The Layperson's Guide to the Delta.

Data

Association of Bay Area Governments. May 1, 1994. Projections 94, and Digital Census Tract Data for Contra Costa County. (Note: Projections 96 is now available.)

Contra Costa Water District. July 1, 1991. 1990 Raw Water Demands of Individual Customers.

Contra Costa Water District. January 14, 1990. Billing Database; Raw Water Sales in Acre-feet for the period 1978-1993.

Contra Costa Water District, Finance Department. February 13, 1991. Billing Database-Sales in Acre-feet, 1990.

Contra Costa Water District. 1986, Amended 1992. Comparison of Water Year Type Classification Schemes, 1922-1991.

Contra Costa Water District. May 13, 1992. Residential Water Duties. Prepared by Christopher Hunt.

Contra Costa Water District. March 13, 1994. Special Consumption Report Showing Consumption in HCF as of 3/13/94; Updated TWSA Monthly Summary 1987-1993.

Contra Costa Water District. July 1995. Ten Year Financial Plan for Fiscal Years 1996-2005.

Contra Costa Water District. February,1994. Treated Water Service Area Customer Data. Monthly Revenue Code Count and Pressure Zone Listings (February 1989-Present).

Agreements

Bureau of Reclamation, Department of Interior. May 1994. Amendatory Contract between the United States and Contra Costa Water District Providing for Water Service and for Facilities Repayment.

California Urban Water Conservation Council. September 1991. Memorandum of Understanding regarding Urban Water Conservation in California.

Contra Costa Water District. October 19, 1995. Agreement between the City of Brentwood and the Contra Costa Water District.

Contra Costa Water District. November 14, 1990. Agreement between the City of Brentwood and Contra Costa Water District.

Contra Costa Water District. May 16, 1990. Agreement between East Contra Costa Irrigation District and Contra Costa Water District.

Contra Costa Water District. April 11, 1991. Contract among the Department of Water Resources of the State of California, East Contra Costa Irrigation District, and Contra Costa Water District.

Contra Costa Water District. March 27, 1993. Memorandum of Understanding between CCWD and DDSD for Water Recycling.

Contra Costa Water District. February 12, 1992. Modification No. 1 to Memorandum of Understanding between CCWD and DDSD dated March 27, 1991.

Correspondence

Bishop, Walter J., General Manager, Contra Costa Water District. October 13, 1994. Memorandum to East County Committee from Walter J. Bishop, Contra Costa Water District, regarding BBID/Cowell Foundation MOU-Status Report.

Gilmore, Rick., Manager, Byron-Bethany Irrigation District. March 31, 1995. Written correspondence to Jay Corey, City Manager, City of Brentwood, regarding responses to the Administrative Draft of City of Brentwood's Interim Water Supply Alternatives Study.

Hamilton, Chuck., Manager Secretary, East Contra Costa Irrigation District. February 16, 1993. Written / faxed correspondence to Austin Nelson, Contra Costa Water District, regarding historical diversions from 1975 - 1988 through Indian Slough and the diversions and use of groundwater for the period 1989-1992.

Jensen, Arthur R., Assistant General Manager, Contra Costa Water District. February 18, 1993. Written correspondence to James W. Cutler, Chief of Comprehensive Planning, Contra Costa County Community Development Department, regarding Notice of Preparation for EIR on Cowell Ranch General Plan Amendment

Yost, Jim, West Yost Associates, Consultant for Water Resources Zone 7 Management; Alameda County Flood Control and Water Conservation District. November 22, 1993. Written correspondence to Rick Gilmore, Manager, Byron-Bethany Irrigation District, enclosing the fully executed agreement between BBID and Zone 7 for the five-year transfer of water.

Publications

Central California Regional Water Recycling Program. January 1995. Newsletter of the Central California Regional Water Recycling Program., Issue 1.

Contra Costa Water District.. June 1993. "Ten Common Questions About the Los Vaqueros Project." The Fact Sheet.

Contra Costa Water District. Spring 1993. "Drought Over, but Conservation Remains a Way of Life". On Tap: A Community Newsletter, Volume 7, Number 1 .

Contra Costa Water District. Summer 1991. "Contra Costa Canal Regional Trail"., "Play it safe this summer on canal trails". On Tap: A Community Newsletter, Volume 5 Number 2.

Contra Costa Water District. March 3, 1993. "1992 Water Quality Report." Drinking Water .

Contra Costa Water District. January,1993. Conduit; CCWD Employee Newsletter. " Los Vaqueros Project Marching Forward".

Contra Costa Water District. March 1993. Surviving the 1992 Drought Together.